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WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

PLEASE CHECK FOR CHANGE INFORMATION AT THE REAR OF THIS MANUAL

413A
PORTABLE NEONATAL MONITOR

SERVICE

INSTRUCTION MANUAL

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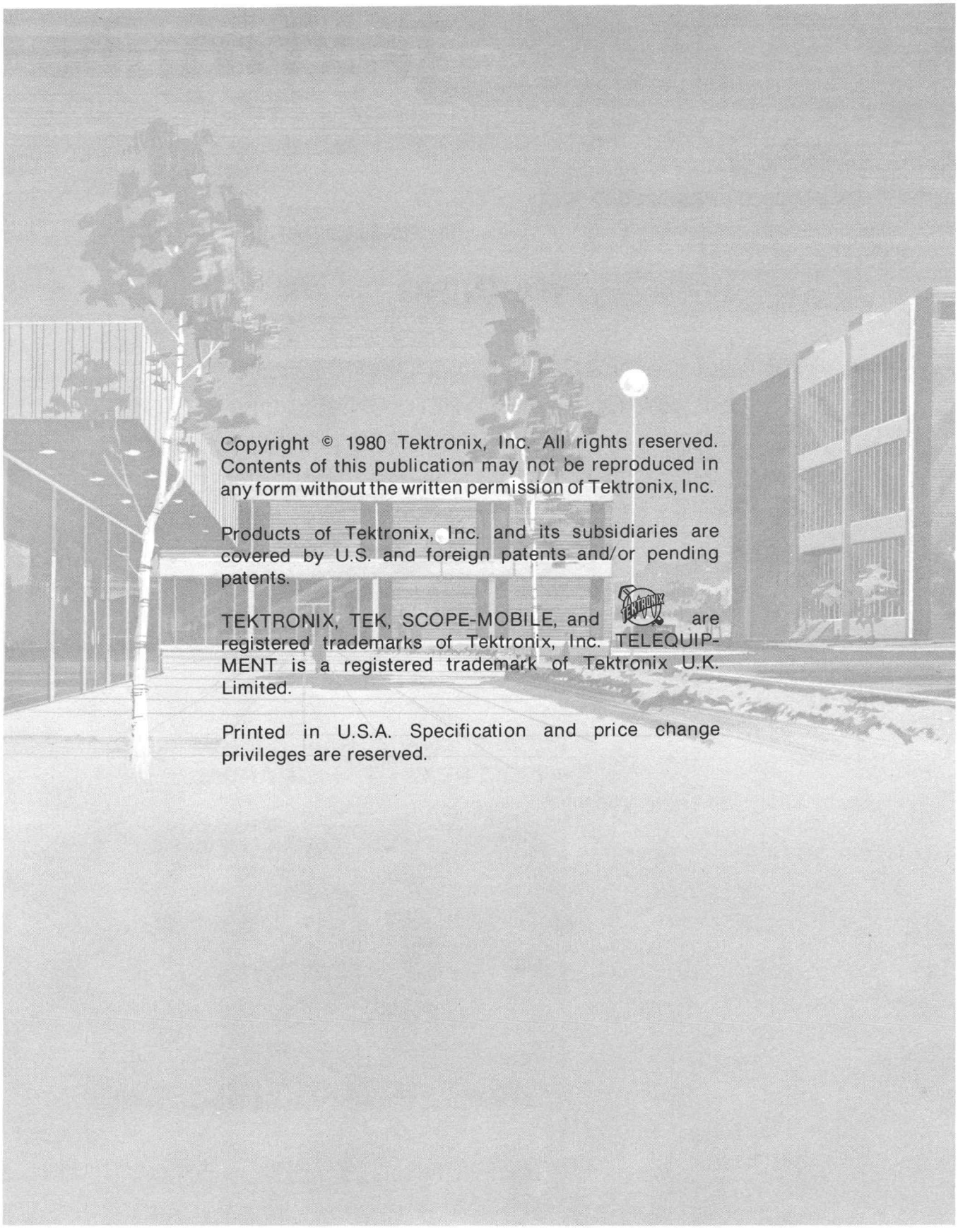


TABLE OF CONTENTS

PAGE

LIST OF TABLES ii
LIST OF ILLUSTRATIONS iii
SAFETY SUMMARY iv

SECTION 1 GENERAL INFORMATION

DESCRIPTION 1-1
SPECIFICATION 1-1
ACCESSORIES 1-15
STANDARD ACCESSORIES 1-15
SPECIFIED OPTIONAL ACCESSORIES 1-15
INSTALLATION 1-16
MOUNTING 1-16

SECTION 2 OPERATING INFORMATION

POWER CONSIDERATIONS 2-1
MAINS POWER OPERATION 2-1
POWER SOURCE 2-1
POWER CORD AND PLUG 2-1
MAINS-CONNECTED INDICATION 2-2
OVERLOAD PROTECTION 2-2
BATTERY OPERATION 2-2
BATTERY STATUS 2-2
BATTERY CHARGING 2-2
BATTERY CONDITIONING 2-3
FUNCTIONS OF CONTROLS, CONNECTORS, AND INDICATORS 2-4

SECTION 3 THEORY OF OPERATION

ECG 3-1
ECG BOARD CIRCUIT FUNCTIONS 3-1
ECG AMPLIFIER CIRCUIT OPERATION 3-1
FLOATING POWER SUPPLY 3-3
FLOATING INPUT AMPLIFIER 3-4
CURRENT TO VOLTAGE CONVERTER 3-4
AC-COUPLED AMPLIFIER 3-4
DISPLAY AMPLIFIER 3-4
TRACE RECOVERY AND LEAD FAULT 3-4
CHANNEL OFF SENSE 3-5
5 V_f AND -5 V_f SUPPLIES 3-5
QRS DETECTOR CIRCUIT OPERATION 3-5
AUTOMATIC GAIN CONTROL (AGC) 3-5
DIFFERENTIATOR AND ABSOLUTE VALUE DETECTOR 3-6
QRS TIMER 3-6
QRS TIMER MODULATOR 3-6
QRS DETECTOR DISABLE 3-6
PACER DETECTOR 3-6
RESPIRATION BOARD 3-7
RESPIRATION BOARD CIRCUIT FUNCTIONS 3-7
RESPIRATION AMPLIFIER CIRCUIT OPERATION 3-7
50 KHZ DRIVER 3-7
SYNCHRONOUS DETECTOR 3-7
AC-COUPLED AMPLIFIER 3-9
DISPLAY AMPLIFIERS 3-9
TRACE RECOVERY AND LEAD FAULT 3-9
RESPIRATION TRACE POSITIONING MULTIPLEXER 3-9
INSPIRATION DETECTOR CIRCUIT OPERATION 3-10
AUTOMATIC GAIN CONTROL (AGC) 3-10
DIFFERENTIATOR AND CLIPPER 3-11
INSPIRATION TIMER 3-11
INSPIRATION DETECTOR DISABLE 3-12
CVA DETECTOR OPERATION 3-12
LOW ECG RATE DETECTOR 3-12

PAGE

PRESSURE/PULSE BOARD 3-14
PRESSURE/PULSE BOARD CIRCUIT FUNCTIONS 3-14
PRESSURE CHANNEL 3-14
PULSE CHANNEL 3-14
CRT TRACE CHOPPING 3-14
CLOCK DIVIDER 3-14
TRIGGER 3-14
SIGNALS TO REMAINDER OF MONITOR 3-14
PULSE AMPLIFIER CIRCUIT OPERATION 3-14
PULSE-SENSOR EXCITATION SUPPLY 3-14
PULSE AMPLIFIER 3-15
PULSE TRACE RECOVERY 3-15
PRESSURE AMPLIFIER CIRCUIT OPERATION 3-15
PRESSURE-TRANSDUCER EXCITATION SUPPLY 3-15
PRESSURE INPUT AMPLIFIER 3-15
CLOCK DIVIDER AND CONTROL LOGIC 3-17
PRESSURE FILTER 3-19
CRT DISPLAY GAIN SWITCHING 3-19
PRESSURE/PULSE-RESPIRATION TRACE CHOPPING 3-19
PRESSURE/PULSE TRIGGER DETECTOR 3-20
PRESSURE/PULSE RESPIRATION DISPLAY AMPLIFIER 3-20
CONDITIONER BOARD 3-21
CONDITIONER BOARD CIRCUIT FUNCTIONS 3-21
RATE AND TEMPERATURE CONVERTER CIRCUIT OPERATION 3-22
HEART RATE CONVERTER 3-22
RESPIRATORY EFFORT RATE CONVERTER 3-22
TEMPERATURE CONVERTERS 3-22
TEMPERATURE PROBE FAULT AND NO-PROBE SENSING 3-22
TEMPERATURE DIFFERENCE AMPLIFIER 3-23
TEMPERATURE OVERRANGE 3-23
PRESSURE CONVERTER CIRCUIT OPERATION 3-23
SYSTOLIC/DIASTOLIC CONVERTER 3-23
MEAN PRESSURE FILTER 3-24
READOUT SELECTOR CIRCUIT OPERATION 3-24
SYSTOLIC/DIASTOLIC SELECTOR 3-26
SIGN ENABLE GATE 3-27
DECIMAL POINT SELECTION 3-27
ALARM CIRCUIT OPERATION 3-27
HEART-RATE AND RESPIRATORY-RATE ALARMS 3-27
WINDOW DETECTOR 3-27
ALARM DELAY 3-27
PRESSURE/PULSE ALARM 3-27
PRESSURE MODE 3-27
PULSE MODE 3-27
RESPIRATORY EFFORT ARREST ALARM DETECTOR 3-27
NON-VIOLATION OPERATION 3-27
VIOLATION OPERATION 3-27
VIOLATION RESET LOGIC 3-27
ALARM LATCH LOGIC 3-28
DISPLAY UNITS LOGIC 3-28
DVM BOARD 3-29
DVM BOARD CIRCUIT FUNCTIONS 3-29
DVM AND DISPLAY CIRCUIT OPERATION 3-29
A/D CONVERTER 3-29
DIGIT-SELECT OUTPUT & INTERDIGIT BLANKING 3-31
ANODE DRIVERS 3-31
DECODER-DRIVER 3-31
LEADING-ZERO SUPPRESSION LOGIC 3-31
DISPLAY UPDATE (DU) AND SAMPLE 3-32
BLANKING LOGIC 3-33
SIGN, DECIMAL, AND 1/2-DIGIT DRIVERS 3-33

SECTION 3 (CONT) PAGE

MAIN BOARD 3-34
MAIN BOARD CIRCUIT FUNCTIONS 3-34
INTERCONNECTION 3-34
MASTER CLOCK AND DIVIDERS 3-34
VERTICAL TRACE CHOPPING 3-34
VERTICAL CIRCUIT OPERATION 3-36
VERTICAL DEFLECTION AMPLIFIER 3-36
HORIZONTAL CIRCUIT OPERATIOIN 3-36
TRIGGER SELECTOR 3-37
SWEEP TRIGGER 3-37
SWEEP GENERATOR 3-37
HORIZONTAL DEFLECTION AMPLIFIER 3-37
AUDIO AMPLIFIER CIRCUIT OPERATION 3-38
ECG/RESP LEAD TEST 3-38
CRT CIRCUIT OPERATION 3-38
CRT BIAS AND BLANKING 3-38
POWER SUPPLY CIRCUIT OPERATION 3-39
AC-LINE VOLTAGE INPUT 3-39
BATTERY CHARGER 3-39
+2.5 V AND +5 V REGULATOR 3-39
POWER SUPPLY CONVERTER 3-39
CONVERTER REGULATOR 3-39
CONVERTER START-UP 3-39
OVERVOLTAGE SHUTDOWN 3-39
BATTERY STATUS 3-39
BATTERY CONDITIONER BOARD 3-42
BATTERY CONDITIONER CIRCUIT FUNCTIONS 3-42
BATTERY CONDITIONER CIRCUIT OPERATION 3-42

SECTION 4 CALIBRATION

INTRODUCTION 4-1
ECG LEAKAGE CHECK 4-1
ADJUSTMENT INTERVAL 4-1
PARTIAL ADJUSTMENT 4-1
TEST EQUIPMENT REQUIRED 4-1
SPECIAL TEST ACCESSORIES 4-3
CHECK/ADJUST PROCEDURE 4-11
A. POWER SUPPLY AND DISPLAY 4-11
B. DIGITAL DISPLAY 4-15
C. TEMPERATURE 4-16
D. PRESSURE/PULSE 4-18
E. ECG 4-21
F. RESPIRATORY EFFORT 4-27
G. CMRR AND LEAKAGE 4-36
H. BATTERY CONDITIONER 4-37

SECTION 5 MAINTENANCE

PREVENTIVE MAINTENANCE 5-1
CLEANING 5-1
EXTERIOR 5-1
INTERIOR 5-1
VISUAL INSPECTION 5-1
EXTERNAL 5-1
INTERNAL 5-1
CABINET REMOVAL 5-1
CALIBRATION 5-2
ECG LEAKAGE CHECK 5-2
TEST EQUIPMENT REQUIRED 5-2
LEAKAGE CHECK PROCEDURE 5-2
TROUBLESHOOTING AIDS 5-3
SERVICING EXTENDER SET 5-3
SCHEMATIC DIAGRAMS 5-3
CIRCUIT BOARD ILLUSTRATIONS 5-3
ADJUSTMENT AND TEST POINT LOCATIONS 5-3
COMPONENT VALUE IDENTIFICATION 5-3
SEMICONDUCTOR LEAD CONFIGURATIONS 5-3
TRUTH TABLES 5-3
TYPICAL POWER SUPPLY VOLTAGES 5-3

SECTION 5 (CONT) PAGE

CORRECTIVE MAINTENANCE 5-7
SERVICE RECORDS 5-7
OBTAINING REPLACEMENT PARTS 5-7
STANDARD PARTS 5-7
SPECIAL PARTS 5-7
ORDERING PARTS 5-7
SOLDERING TECHNIQUES 5-7
COMPONENT REMOVAL AND REPLACEMENT 5-7
BATTERY PACK 5-7
INSTRUMENT DISASSEMBLY 5-9
PUSHBUTTONS 5-9
INTERCONNECTING CABLES AND PUSHBUTTON-EXTENSION SHAFTS 5-9
TERMINAL CONNECTORS 5-9
SEMICONDUCTORS 5-10
INTERCONNECTING CIRCUIT-BOARD PINS 5-10
FRONT PANEL 5-11
FRONT ASSEMBLY 5-11
CIRCUIT BOARDS 5-13
ZERO CONTROL 5-15
QRS AND INSPIRATION LED 5-15
CRT 5-15
ACCESSORY REPAIR 5-16
PRESSURE TRANSDUCERS 5-17
ECG CABLES 5-17

SECTION 6 OPTIONS

SECTION 7 REPLACEABLE ELECTRICAL PARTS

SECTION 8 DIAGRAMS

SECTION 9 REPLACEABLE MECHANICAL PARTS

CHANGE INFORMATION

LIST OF TABLES

TABLE NO.		PAGE
1-1	Electrical Characteristics	1-1
1-2	Environmental Characteristics	1-13
1-3	Physical Characteristics	1-14
2-1	Battery Condition Indicator	2-2
2-2	Battery Charging and Operating Times	2-3
3-1	Trace Positioning Logic	3-10
3-2	Readout Selector Address Assignments	3-25
3-3	Truth Table for U3624A and C	3-28
3-4	Truth Table for BCD Output of U3921	3-29
4-1	Adjustments Needed after Assembly Replacement	4-1
4-2	Test Equipment	4-2
4-3	Power Supply Limits	4-12
4-4	413A Sweep Speed Accuracy	4-14
4-5	Temperature Test Accuracy	4-17
4-6	Pressure Display and Readout Accuracy	4-19
4-7	Heart Rate Readout Limits	4-25
4-8	Heart Rate Limit Control Range	4-26
4-9	Heart Rate Accuracy	4-30
4-10	Resp Rate Alarm Limits Range	4-30
4-11	Possible Frequency Counter Error Due to Triggering Error	4-33
5-1	Power Supply Voltages	5-6

LIST OF ILLUSTRATIONS

FIGURE NO.		PAGE
	413A Neonatal Monitor	vi
1-1	Dimensional outline drawing	1-14
1-2	Installing mounting stand to tubular object (pipe) or side cabinet	1-17
1-3	Installing mounting adapter to monitor	1-18
1-4	Mounting monitor to mounting stand	1-18
2-1	Line-voltage switch (rear panel)	2-1
2-2	BATTERY condition indicator (LED)	2-2
2-3	Front-panel controls and indicators (1 through 14)	2-4
2-4	Front-panel controls and indicators (15 through 34)	2-5
2-5	Side-panel ECG/RESP LEAD TEST terminals	2-8
2-6	Left-side panel battery conditioner START button/indicator	2-9
2-7	Rear-panel controls and connectors	2-10
3-1	ECG amplifier block diagram	3-2
3-2	QRS detector block diagram	3-3
3-3	Respiration amplifier block diagram	3-8
3-4	Inspiration detector block diagram	3-11
3-5	CVA detector timing	3-13
3-6	Pressure amplifier block diagram	3-16
3-7	Pressure amplifier timing	3-17
3-8	Clock divider and control logic	3-18
3-9	Pressure/pulse-respiration trace-chopping logic	3-19
3-10	Pressure/pulse trigger points	3-21
3-11	Systolic/diastolic switching points	3-24
3-12	Logic signals generated during systolic/diastolic selection	3-26
3-13	Integrator waveform at pin 6 of U3921	3-29
3-14	Equivalent circuit diagram of the analog section of U3921 during Segment 4	3-30
3-15	Digital select timing diagram	3-30
3-16	Timing diagram for digital select and inter-digit blanking	3-32
3-17	Data update sequence	3-33
3-18	Trace-switching logic	3-35
3-19	Vertical-deflection amplifier basic circuit concepts	3-36
3-20	Over-voltage shutdown block diagram	3-41
4-1	ECG/Resp test fixture	4-4
4-2	Temperature sensor simulators	4-5
4-3	Optional pressure transducer simulators	4-6
4-4	Pulse test fixture	4-7
4-5	Precision test fixture	4-8
4-6	ECG low-pass filter	4-9
4-7	Resp low-pass filter	4-9
4-8	CMRR test fixture	4-10
4-9	Optional pressure transducer simulator zero adjustment waveform	4-10
4-10	Spot-centering and focus adjustments	4-12
4-11	Horizontal Position and Width adjustment setup	4-13
4-12	Horizontal Position and Width adjustments	4-14
4-13	QRS timer duration waveform	4-22
4-14	QRS inhibit duration waveform	4-22
4-15	Pacer test setup	4-23
4-16	Inspiration timer duration waveform	4-28
4-17	Inspiration inhibit duration waveform	4-29
4-18	Respiratory effort waveform transition amplitude measurement points	4-29
4-19	Test setup to check CVA rejection	4-32
4-20	CVA test waveforms	4-33
4-21	Respiratory effort bandwidth droop waveform	4-35
4-22	Respiratory effort risetime waveform	4-35
5-1	Board retainer clip installation	5-2
5-2	Color-coded-component value identification	5-4
5-3	Semiconductor lead configurations	5-5
5-4	Circuit-board locations	5-8
5-5	Removing pushbutton extension shaft	5-9
5-6	Installation and orientation of terminal connectors	5-10
5-7	View of typical circuit-board pin and ferrule	5-11
5-8	Crt-anode connector removal and installation	5-11
5-9	Main and conditioner board cable connections	5-12
5-10	ECG shield installation	5-13
5-11	QRS and INSPIRATION LED replacement	5-16

The illustrations in Section 8 are located near their associated diagrams on the foldout pages.

8-1	Semiconductor lead configurations
8-2	Color-coded-component value identification
8-3	IC truth tables
8-4	Circuit board locations
8-5	A30—ECG board component locations
8-6	A31—Respiration board component locations
8-7	A32—Pressure/Pulse board component locations
8-8	A33—Conditioner board component locations
8-9	A34—Rate Alarm Control board component locations
8-10	A35—Readout Switch board component locations
8-11	A39—Sweep Switch board component locations
8-12	A36—DVM board component locations
8-13	A37—Digital Display board component locations
8-14	A38—Main board component locations
8-15	A20—Battery Conditioner board component locations
8-16	A21—Battery board component locations
8-17	A22—Start Switch board component locations
8-18	A40—High Voltage board component locations
8-19	Board pin assignments
8-20	Test point and adjustment locations
8-21	ECG/Resp cable
8-22	Temperature sensor plug
8-23	Three-circuit ¼-inch phone plug, used for inter-connecting signals at rear-panel input/output jacks
8-24	Pulse sensor cable
8-25	Pressure transducer cable

SAFETY SUMMARY

The general safety information in this summary is for both operating and servicing personnel. Specific warnings and caution will be found throughout the manual where they apply, but may not appear in this summary.

Terms In This Manual

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

Terms As Marked on Equipment

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

Symbols In This Manual


This symbol indicates where applicable cautionary or other information is to be found.

Symbols As Marked on Equipment


DANGER—High voltage.


Protective ground (earth) terminal.


ATTENTION—refer to manual.

Power Source

This product is intended to operate from a power source that does not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

The monitor is compatible with isolated power systems as used in operating rooms.

Do Not Operate Monitor In an Explosive Atmosphere

Do not operate the monitor in the presence of flammable gasses or anesthetics. Explosion can result from operation in such an environment. Safety document NFPA 56A, Standards for the Use of Inhalation Anesthetics, states that portable electronic equipment (such as this monitor) must not be operated at less than 5 feet above the floor in the presence of flammable anesthetics.

Use the Proper Power Cord

Use only the power cord and connector specified for your monitor. Use only a power cord that is in good condition.

The monitor requires a three-wire (18-gauge, SJT-grade) power cord which is supplied with a three-terminal polarized plug (Hospital Grade) for connection to the power source and protective ground. The ground (earth) terminal of the plug is directly connected to the frame of the monitor. For electric-shock protection, insert this plug only in a mating "Hospital Grade" power outlet with a protective-ground contact. Do not defeat the grounding connection. Any interruption of the grounding connection can create an electric-shock hazard. If in doubt about socket-outlet ground, consult with qualified service personnel.

For detailed information on power cords and connectors, see Optional Accessories list.

Use the Proper Fuse

To avoid fire hazard, use only the fuse specified for your product, and which is identical in type, voltage rating, and current rating. Refer fuse replacement to qualified service personnel.

Use Only Safe Methods of Interconnection

To ensure protection against electrical shock from the monitor cabinet, whenever auxillary line-operated equipment is electrically connected to the monitor, the monitor must be properly grounded. When the monitor is connected to other line-operated equipment, battery operation should be avoided. If it cannot be avoided, the monitor must be grounded using the terminal provided on the rear panel. It is extremely important that equipment interconnections be made in accordance with NFPA No. 70, National Electrical Code, Article 517, "Health Care Facilities." Compliance with paragraph 517-80 and 517-120 is especially important.

NOTE

Within certain governmental jurisdictions, all interconnected accessory equipment must be labeled by an approved testing laboratory. After interconnection with accessory equipment, leakage current and grounding requirements must be maintained.

Use Proper Electrocautery Return Circuit

Avoid electrocautery burns at monitoring sites by ensuring proper connection of the electrocautery return circuit. If improperly connected, many older electrocauterizers allow other return paths, even through fully isolated patient monitors.

Do Not Remove Covers or Panels

To avoid personal injury, do not remove the protective instrument covers or panels.

Component replacement and internal adjustments must be made by qualified service personnel only.

Use Only Recommended Accessories

To ensure patient safety, use only accessories recommended by Tektronix, Inc.

For a list of accessories that are recommended by Tektronix, Inc. for use with the 413A Monitor, see Accessories Section at the back of the Operators Manual.

Do Not Mount Monitor Directly Above Patient

Place the monitor in a location where it cannot harm the patient should it fall from its shelf or other mount.

Use Only Recommended Sterilization Methods

Do not autoclave the monitor.

Do Not Autoclave Accessories unless the manufacturer's instructions clearly approve this procedure. Many accessories can be severely damaged by autoclaving; also inherent isolation may be destroyed.

Make Periodic Safety Inspections

Inspect the power cord periodically for fraying or other damage, and replace as needed. Do not operate the apparatus from mains power with a damaged power cord or plug.

Frequent electrical and visual checks should be made on cables and electrode wires. Broken or frayed electrode wires, or loose snap-fittings may cause interference or loss of signal. Particular attention should be paid to the point at which the wire enters the terminals, since flexure will eventually cause breakage of strands at this point. Wires may be electrically checked prior to patient attachment by using the ECG/RESP LEAD CHECK terminals on the right-hand side of the monitor.

Monitors that have been dropped or severly abused should be checked by qualified service personnel to verify acceptable patient input leakage current.

SAFETY DOCUMENTS

Additional safety information can be found in the following documents:

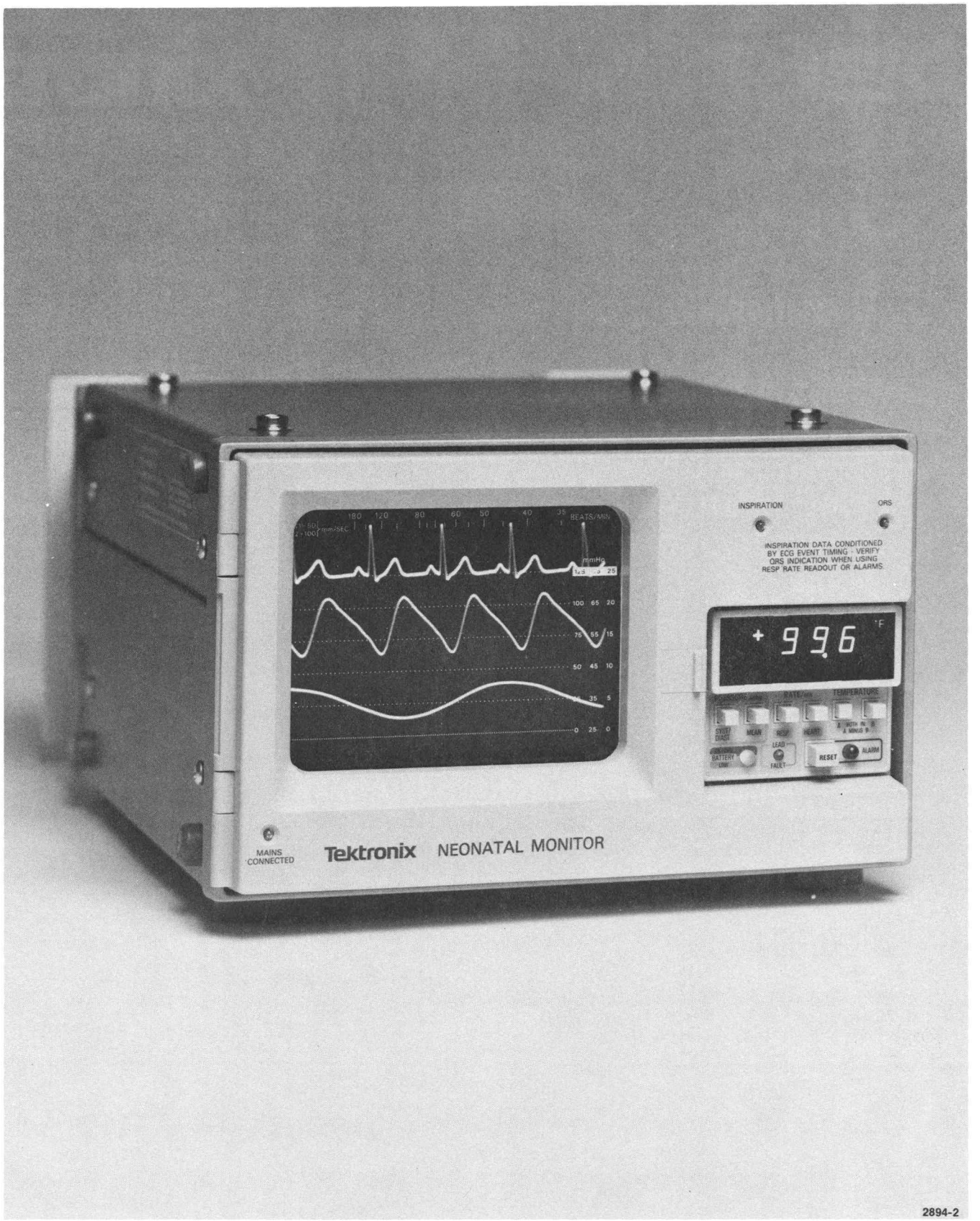
1. Canadian Standards Association 178 Rexdale Blvd., Ontario Canada M9W 1R3; CSA Standard C22.2, No 125, Electro-Medical Equipment.

2. Underwriters Laboratories, Inc. 1285 Walt Whitman Road, Melville, L.I., New York 11746, UL544, Standard for Safety, Medical and Dental Equipment.

3. National Fire Protection Association (NFPA), 470 Atlantic Avenue, Boston, Massachusetts 02210.

   a. NFPA NO 56a, Standard for the Use of Inhalation Anesthetics.

   b. NFPA NO. 70, National Electrical Code.



413A Neonatal Monitor.

GENERAL INFORMATION

DESCRIPTION

The 413A is a three-trace portable patient monitor that simultaneously displays ECG, blood-pressure or peripheral-pulse, and respiratory-effort waveforms.

The monitor can be operated from mains power or the internal rechargable battery pack. A color-changing LED (Light-Emitting Diode) indicates battery condition. The battery pack features a cell conditioner that ensures consistent battery operating time.

A selectable digital readout shows heart rate, respiratory effort rate, systolic/diastolic and mean blood pressure, either of two temperatures, or temperature difference.

Independently adjustable alarm limits are provided for heart rate and respiratory effort rate. Audible and visual alarm indications are provided for violations of heart-rate and respiratory-effort-rate high/low limits, for insufficient pulse display amplitude or insufficient pulsatile pressure, and for inadequate respiratory effort. Independent controls are provided for continuous-tone-alarm loudness and for beat-tone loudness. Separate QRS and INSPIRATION detectors provide information for the alarms, rate digital display, and sweep triggering.

Circuitry is provided to reduce the possibility of false inspiration detection due to cardio-vascular artifacts (CVA).

The respiratory effort arrest alarm contains counting and timing circuits to improve artifact rejection and increase sensitivity to inadequate periodic breathing effort.

ECG/RESP LEAD TEST signal source and the LEAD FAULT indicators provide for on-location evaluation of common cable and electrode problems.

A TEMP TEST button checks accuracy of temperature readout.

The power cord is detachable to facilitate repair and to accommodate various export needs. A front-panel MAINS CONNECTED indicator verifies primary circuit continuity.

SPECIFICATION

Unless otherwise specified, electrical characteristics apply over an ambient temperature range of 0° to 50° C when the monitor has been calibrated in a +25° C, ±5° C environment.

TABLE 1-1
Electrical

Characteristic	Performance Requirement	Supplement Information
ECG		
INPUT		
Lead Selection	ECG CHANNEL OFF, Lead I, Lead II, Lead III.	
Isolation	Instrument only— does not include effects of patient cable.	
Capacitance		Less than 75 pF.
Resistance		Greater than 10 kM ohms.
Leakage Current	Less than 10 microamps rms at 50/60 Hz and all rated mains input voltages.	
Breakdown	Greater than 2.5 kV rms at 50/60 Hz between isolated and grounded circuits.	Greater than 5 kV dc between isolated and grounded circuits.
Self Protection		
Defibrillator and Cauterizer	Monitor may remain connected to patient during defibrillation and electrocautery when using Tektronix patient cable.	No damage to monitor when patient cable contains 1000 ohm resistors in series with each electrode.

TABLE 1-1 (CONT)
Electrical

Characteristic	Performance Requirement	Supplement Information
ECG (cont)		
TRANSFER CHARACTERISTICS		
Bandwidth	0.5 Hz (±25%) to 50 Hz (±25%) at −3 dB points.	
CMRR	No less than 500,000:1 at 50/60 Hz with 15 k ohm maximum electrode resistance and 5 k ohm imbalance.	No less than 350,000:1 at 10 k ohm imbalance.
Input Signal Dc Offset Range	No degradation of signal having ±250 mV or less dc offset.	
Overdrive Trace Recover	2 seconds or less.	1 second typical.
Noise	Less than 10 microvolts rms referred to input.	As measured with true rms responding meter at ECG rear panel output. Bandwidth limited to 100 Hz.
Lead Fault Light	Indicates loss of effective ECG amplifier input connection to patient.	
Trace Baseline Overshoot Following Pacer Signal		Less than 250 microvolts, referred to input.
Input to Display Sensitivity	20 mm/mV ±10% when SIZE control is set at index on front panel. Variable from at least X1/2 to X2 from index.	Typical variable range: X1/3 to X3.
Input to Output Gain	X1000 ±5%.	±5 V minimum linear output range when status of SIZE control and automatic trace positioning are such that signal is displayed completely on screen. ±12 V out maximum during overdrive conditions. Less than 100 ohm R_o single-ended output shortproof to ground. Load resistance 100 k ohm min.
QRS DETECTOR		
Initializing Time	Less than 10 seconds.	
R-Wave Edge Timer		Initial value, 5 ±1 ms. Self-adjusting between 5 and 8 ms.
Inhibit Timer and QRS Output Pulse Width		150 ms ±25 ms.

TABLE 1-1 (CONT)
Electrical

Characteristic	Performance Requirement	Supplement Information
ECG (cont)		
ECG TEST SIGNAL		
Amplitude		
Lead I		1.0 mV ±5%
Lead II		1.5 mV ±5%
Lead III		0.5 mV ±5%
Rate		117 ±0.5 bpm
RESPIRATION		
INPUT		
Leads Monitored	LA to RA, independent of ECG lead selector.	
Technique	Constant current impedance pneumography.	
Excitation Frequency		50 kHz
Excitation Amplitude	70 microamps rms ±50%.	200 microamps p-p ±50%.
Patient Source Impedance Range	0 to 1.5 k ohm @ 50 kHz.	As measured from LA to RA at patient cable branch block.
Isolation (Combined Total ECG and Resp)	Instrument only — does not include effects of patient cable.	
Capacitance		Less than 75 pF.
Resistance		Greater than 10 kM ohms.
Leakage Current	Less than 10 micro amps rms at 50/60 Hz and all rated mains input voltages.	
Breakdown	Greater than 2.5 kV rms at 50/60 Hz between isolated and grounded circuits.	Greater than 5 kV dc between isolated and grounded circuits.
Self Protection (ECG and Resp)		
Defibrillator and Cauterizer	Monitor may remain connected to patient during defibrillation and electrocautery when using Tektronix patient cable.	No damage to monitor when patient cable contains 1000 ohm resistors in series with each electrode.
TRANSFER CHARACTERISTICS		
Bandwidth	0.1 Hz (±25%) to 4 Hz (±25%) at -3 dB points.	
Noise	Less than 25 milliohms rms at 750 ohm input source impedance, referred to input.	As measured with true rms responding meter at Resp rear panel output. Bandwidth limited to 10 Hz.
Overdrive Recovery	5 seconds or less.	2 seconds typical.

TABLE 1-1 (CONT)
Electrical

Characteristic	Performance Requirement	Supplement Information
RESPIRATION (cont)		
TRANSFER CHARACTERISTICS (cont) Lead Fault Light	Responds to information from from ECG or Respiratory Effort channel.	Activation from respiration channel indicates unsuitable conditions in LA to RA lead/electrode system for respiratory effort monitoring.
Input to Display Sensitivity	10 mm/ohm ±25% when SIZE control is set at index on front panel. Variable from at least X1/4 to X4.	Typical variable range: X1/5 to X5.
Display to Output Sensitivity	0.5 V/cm of display, ±20%.	±5 V minimum linear output range when signal is completely on screen. ±12 V maximum during overdrive conditions. Less than 100 ohms R_o single-ended output short-proof to ground. Load resistance 100 k ohm minimum.
INSPIRATION DETECTOR Initializing Time	Less than 30 seconds.	
Inspiration Phase Timing		100 ms ±15 ms.
Inhibit Time and Inspiration Output Pulse Width		150 ms ±25 ms following end of inspiration phase.
CVA Detector Timer	270 ms ±10%	CVA = Cario-Vascular Artifact.
RESP TEST SIGNAL Amplitude		1 ohm ±10% between LA and RA.
Source Resistance Rate		755 ohm ±10%. 29 ±0.5 breaths/min
PRESSURE/PULSE		
PRESSURE Ranges		All three ranges can provide one centimeter of display above and below the marked scale.
0-125	-25 to +150 mmHz.	
25-75	+15 to +85 mmHg.	
0-25	-5 to +30 mmHz.	

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TABLE 1-1 (CONT)
Electrical

Characteristic	Performance Requirement	Supplement Information
PRESSURE/PULSE (cont)		
PRESSURE (cont)		
Waveform Display Accuracy	Within 5% of full scale or 3 mmHz, whichever is greater, on each graticule range.	
Pressure Output (rear panel)	0.5 V/cm of display.	-0.5 V to +3.0 V full scale on each range. ±7 V out maximum during overdrive conditions. Less than 100 ohms R_o single-ended output short-proof to ground. 100 k ohms or more load resistance.
Pressure Output Accuracy	Within 2% of reading, or a voltage equivalent to 3 mmHg, whichever is greater.	Scale factor varies, depending on pressure range selected.
Zero Adjust		±150 mmHg typical range
Zero Drift		3 mmHg per hour maximum, after 5 min warmup.
Excitation Voltage		+8 V and -8 V, within 5%.
Transducer Bridge Resistance Range		200 to 1000 ohms.
Excitation Time		1 ms each cycle. 0.125 duty cycle.
Excitation Frequency		125 Hz
Bandwidth		Dc to 20 Hz ±25%.
100 mm TEST		100 mmHg ±2%. Pressure readout will read 95-105 mmHg.
PULSE		
SIZE Range	15:1 or more.	20:1 typical.
Pulse Output (Rear Panel)	0.5 V/cm of display, within 10%	-0.5 V to +3.0 V full scale on each range. ±7 V out maximum during overdrive conditions. Less than 100 ohms R_o single-ended output short-proof to ground. 100 k ohms or more load resistance.
Overdrive Recovery	15 seconds or less	
Excitation Voltage		+3.6 V dc ±10%.
Input to Display Sensitivity		1.1 mV/cm ±25% with PULSE SIZE at index. Variable from ≈0.55 to ≈13.5 mV/cm with PULSE SIZE centered.

TABLE 1-1 (CONT)
Electrical

Characteristic	Performance Requirement	Supplement Information
PRESSURE/PULSE (cont)		
READOUT BLANKING		Causes readout to blank for SYST/DIAST or MEAN selections which are invalid for Pulse or when transducer is not connected.
Crt Blanking		Crt pressure display is turned off with no pressure transducer.
ALARMS		
HEART RATE		
Limits		
HIGH Range	100 (±3) to 250 (±5) beats/min	
LOW Range	0 (±3) to 150 (±3) beats/min	
Accuracy		Discrepancy between digital readout of rate and threshold setting of limit control (as read on digital readout) which causes an alarm will be less than 3 beats/min.
Violation Criterion	Heart-rate alarm is triggered when the average heart rate remains outside of selected limits for 3-15 seconds.	
RESPIRATORY EFFORT RATE		
Limits		
HIGH Range	0 (±3) to 120 (±3) breaths/min	
LOW Range	0 (±3) to 75 (±3) breaths/min	
Accuracy		Discrepancy between digital readout of rate and threshold setting of limit control (as read on digital readout) which causes an alarm will be less than 3 breaths/min.
Violation Criterion	Respiratory Effort-rate alarm is triggered when the average respiration rate remains outside of selected limits for 3-15 seconds, or when ECG rate falls below 60 ±10 beats/min.	Low ECG rate alarm delay is 5 ±3 sec after step change in ECG rate from 120 to 0 bpm.

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TABLE 1-1 (CONT)
Electrical

Characteristic	Performance Requirement	Supplement Information
ALARMS (cont)		
RESPIRATORY EFFORT ARREST Violation Criteria	Alarm is triggered when: a. No inspirations are sensed during a qualifying period, and b. The remainder of the DELAY period passes without the Violation-Reset Criteria being met, or if ECG rate falls below 60 ±10 beats/min.	
Violation-Reset Criteria 10 Sec DELAY	Two breaths must be sensed. The time between these two breaths must be less than the breath-to-breath timer interval.	
20 Sec DELAY	A series of 3 breaths must be taken. Of these 3 breaths, the time between any two consecutive breaths must be less than the breath-to-breath timer interval.	
Timer Intervals DELAY		10 ±3 sec (DELAY at 10) 20 ±6 sec (DELAY at 20).
Qualifier		4 ±1 sec.
Breath-to-Breath		5 ±1 sec (DELAY at 10) 7 ±2 sec (DELAY at 20)
Low ECG rate Delay		5 ±3 sec after a step change in ECG rate from 120 to 0 beats/min.
PULSE ALARM Violation Criteria Pulse	Alarm is triggered when the pulse display amplitude remains below 0.3 cm for 3–15 seconds.	Alarm will not be triggered if the pulse display exceeds 0.5 cm.
Pressure	Alarm is triggered when average pulsatile pressure (systolic minus diastolic) remains below 5 mmHg for 3–15 seconds.	Alarm will not be triggered when average pulsatile presure exceeds 10 mmHg.
ALARM OUTPUT Front Panel	Flashes alarm lamp (red); sounds audio continuously.	Flash rate 7.5 ±2.5 Hz
Rear Panel	Signal provided between ring and barrel of rear panel phone jack.	12 mA current source voltage limited at about +5.5 V; +7 V maximum.

TABLE 1-1 (CONT)
Electrical

Characteristic	Performance Requirement	Supplement Information
ALARMS (cont)		
RESET Front Panel	Clears audio and external alarm for 45 seconds (±15 seconds); lamp turns off if violation clears during 45 seconds audio is off. Pushing RESET turns off lamp if pushed after violation clears. Audio clears when violation clears, independent of reset action. Pushing RESET anytime during violation starts 45 second delay over again.	
Rear Panel (remote)	Switch closure between tip and barrel of phone jack on rear panel will reset alarm only if violation has cleared.	Requires no more than 100 micro amps current sink to reset alarm.
DIGITAL DISPLAY		
TYPE	Gas-discharge, .33 inch high.	Beckman SP331-02, SP332-01
TURN-ON DELAY	Within 10 seconds of instrument turn-on.	1 second typical.
UPDATE TIME	Between 0.75 and 1.25 sec.	1 sec typical. During overrange or push-to-read functions, update rate is 5 Hz ±50%.
OVERRANGE FLASH RATE		5 Hz ±50%.
POLARITY	± signs automatically displayed in pressure and temperature modes.	
ZERO SUPPRESSION	All leading zeros blanked except the one just preceding the decimal.	
HEART RATE Source	ECG, whenever channel is on; Pressure or Pulse when ECG is off.	
Overrange Indication		Any R-R interval corresponding to a value greater than 300 bpm ±10% causes readout to flash.
Accuracy (30 to 250 bpm)	2% of reading or 3 bpm, whichever is greater.	
Response Time	Settles to final value, ±5% of step, within 12 seconds after step change in rate.	10 seconds typical.
Ripple (at 30 bpm)	2 bpm or less.	1 bpm typical.

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TABLE 1-1 (CONT)
Electrical

Characteristic	Performance Requirement	Supplement Information
DIGITAL DISPLAY (cont)		
RESPIRATORY EFFORT RATE		
Readout Blanking		Respiratory-effort rate readout is blanked when respiratory effort channel is off.
Overrange Indication		Any breath-to-breath interval corresponding to a value greater than 150 breaths/min ±10% causes readout to flash.
Accuracy (5 to 120) breaths/min)	±3 breaths/min.	
Response Time	Settles to final value, ±5% of step, within 35 seconds after step change in rate.	30 seconds typical.
Ripple (at 5 breaths/min)	2 breaths/min or less.	1 breath/min typical.
PRESSURE		
Range	-25 to +175 mmHg.	
Source	Pressure channel when any pressure range is selected.	
Readout Blanking		Pulse selection causes pressure readout to blank. Also readout is blanked when pressure transducer is not connected.
Accuracy	2% of reading or 3 mmHg, whichever is greater, excluding transducer error and zero imbalance.	
Systolic/Diastolic Display Cycle	3 seconds ±25%.	ONE COMPLETE CYCLE Systolic 0.9 second Blank 0.1 second Diastolic 0.9 second Blank 1.1 seconds (Typical values)
Mean		Systolic/Diastolic peaks must be within selected range (on screen).
Zero	Set with front panel control. Pressing control allows zero reading be viewed on digital display.	
Drift		3 mmHg/hour maximum after 5 minute warmup.
Systolic/Diastolic/ Mean Response Time	Settles to final value, ±5% of step, within 12 seconds after step change in pressure.	10 seconds typical.
Ripple (at 30 bpm)	2 mmHg or less.	1 mmHg typical.

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TABLE 1-1 (CONT)
Electrical

Characteristic	Performance Requirement	Supplement Information
DIGITAL DISPLAY (cont)		
PRESSURE (cont)		
Overrange Indication	Digital display flashes when pressure input falls outside of the following range. even momentarily: -50 ±30 to 200 ±30.	Flashing stops 2-5 seconds after removal of overrange condition.
TEMPERATURE		
Accuracy (with Yellow Springs Instrument Co. 700 Series Probes)		Also applies to other probes with equivalent specifications.
Temp A or B	±0.3° C or ±0.5° F over a range of +5° C to +45° C or 41° F to 113° F for instrument ambient temperature from +15° C to +35° C.	±0.5° C or ±0.9° F over same range for full instrument ambient temperature range of 0° C to +50° C.
Temp A-B	±0.6° C or ±1.0° F over a range of +5° C to +45° C or 41° F to +113° F for instrument ambient temperature range of +15° C to +35° C.	
Response Time (Instrument only)	Settles to within 0.1° C or 0.2° F of final reading within five seconds after step function change in probe electrical output.	Probe thermal response time (electrical output due to a temperature change) as per probe manufacturer's specifications.
Overrange Indication		Digital display flashes when temperature is less than a value between -10° C and -5° C or greater than a value between +45° C and +50° C (+14° F and +23° F, +113° F and 122° F).
No-Probe or Probe Fault Indication	Digital display blanks if: a. T1 and/or T2 short. b. T1 opens c. Probe not inserted or partially inserted. d. Probe common opens.	Display is obviously low if T2 opens. Digital display reads about -3° C for a probe temperature of +10° C rising to a reading of about +16.5° C for a probe temperature of +45° C.
Temperature Test	Temperature display reads 38.5 ±0.2° C or 101.3 ±0.3° F.	Simulated temperature accuracy at temperature channel input is ±0.1° C or F.

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TABLE 1-1 (cont)
Electrical

Characteristic	Performance Requirement	Supplement Information
WAVEFORM DISPLAY AND AUDIO		
SWEEP		
Speeds	12.5, 25, 50, 100 mm/second.	
Accuracy	Within 10% of reading at 50 and 100 mm/sec, rated against heart-rate scale, for ambient temperature range +15 to +35° C.	Within 10% of reading at 12.5 and 25 mm/second, rated against external metric scale, for ambient temperature range +15 to +35° C.
Triggering	Sweep is triggered only on 50 and 100 mm/sec speeds.	Sweep is free-running on 12.5 and 25 mm/sec speed.
Auto Baseline Delay	3 to 5 seconds after last trigger (baseline in absence of trigger).	4 seconds typical.
CRT CATHODE CURRENT		
AUDIO		
Alarm	Continuous tone.	
Beat Tone	Burst of same tone as alarm.	
POWER		
MAINS INPUT		
Voltage Range		With battery pack installed and at full charge, normal monitor operation is maintained during brief mains transients below rated range.
115 Vac	98 to 132 Vac.	
230 Vac	195 to 250 Vac.	
Frequency	48 to 66 Hz.	Operates to 440 Hz. Safety leakage limits excepted.
Power Consumption		45 watts max. at all rated inputs.
Fusing	One fuse (Std). Two fuses (Europe).	
115 V Range	0.5 A, 250 V, Fast Blo 3AG or 5 x 20 mm.	
230 V Range	0.3 A, 250 V, Fast Blo 3AG or 5 x 20 mm.	
Isolation (primary to secondary and primary to core)		
Breakdown	2500 V 50/60 Hz rms or more without breakdown.	
Chassis Leakage Current	Less than 100 micro A at 50/60 Hz and all rated input voltages. (Protective ground wire current.)	

TABLE 1-1 (cont)
Electrical

Characteristic	Performance Requirement	Supplemental Information
POWER (cont)		
INTERNAL BATTERY (F cells)		
Voltage		5.0 nominal.
Operating Time	1.5 hours minimum with new battery, operating in dual-trace mode with pulse sensor attached and all traces on screen. Battery must have been charged for 14-16 hours in ambient temperature environment between 0° C and 25° C, with monitor turned off.	2.6 hours typical.
Battery Status Indicator	Red/green LED changes color from green to orange to red to indicate battery status.	
Charging Current		560 mA ±60 mA
Low-Battery Shutdown		4.6 V ±50 mV.
Automatic Battery Selection	Battery operation is automatically selected when mains power fails or power cord is disconnected.	Automatic battery selection occurs below about 20% of normal mains voltage.
BATTERY CONDITIONER	Discharges battery and then switches to normal charging mode. START indicator is lit during discharge cycle.	Removes cell depression and other memory effects to restore full battery operating time.
Discharge Time		8 hours or less.
Total Cycle Time		24 hours or less.
Start Conditions	START button activates discharge cycle only when mains power is connected and instrument is turned off.	
Stop Conditions	Discharge cycle ends when battery is discharged sufficiently, or if mains power is disconnected, or if instrument is turned on.	
INTERNAL SUPPLY VOLTAGES		
Over-voltage Shut Down (differential voltage between +7 V and −7 V)		14.8 V to 17.4 V

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TABLE 1-2
Environmental

Characteristic	Performance Requirement	Supplemental Information
GENERAL	Meets environmental performance requirements as specified in MIL-T28800, Type III Class 3, Style D, as revised in Tek Standard No. 062-2853-00, with exceptions as noted below.	
TEMPERATURE Operating	0° C to +50° C. While total instrument operation is ensured over this temperature range, some parameters may have accuracy specifications over the limited ambient temperature range of +15° C to +35° C.	Battery charging should be done in an environmental temperature between 0° C and 25° C. The higher the temperature above +25° C the less charge the battery will accept, regardless of attempted compensation through extended charge time.
Storage	−40° C to +60° C.	
ALTITUDE	No exceptions to Tek Standard. To 15,000 feet.	
HUMIDITY		Some temporary abnormalities (reversible and not safety related) may occur during temperature extremes at maximum humidity.
SHOCK	No exceptions to Tek Standard.	
VIBRATION (Operating)		Some mechanical amplification in circuit boards at some frequencies.
TRANSPORTATION Package Drop and Vibration	No exceptions to Tek Standard.	

TABLE 1-3
Physcial

Characteristic	Description
WEIGHT	7 kg (16 lbs)
HEIGHT	14.1 cm (5.6 in)
Including Feet and Snaps	15.3 cm (6.0 in)
WIDTH	23.1 cm (9.0 in)
Including Handle	23.9 cm (9.4 in)
Including Handle and Adapter	25.5 cm (10.03 in)
DEPTH	25.6 cm (10 in)
Including Cord Wraps and Knob Protrusion	31.8 cm (12.5 in)

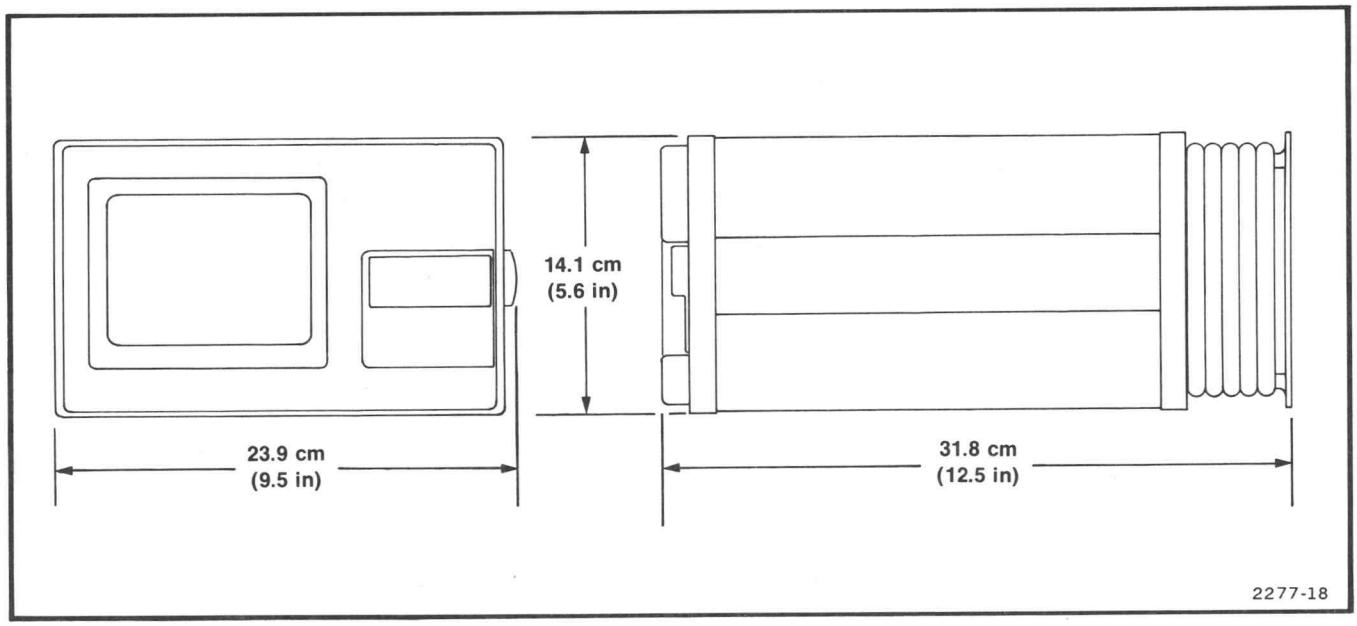

Fig. 1-1. Dimensional outline drawing.

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ACCESSORIES

STANDARD ACCESSORIES

The following accessories are included with the 413A Monitor:

1 ea ..... Operators Manual

1 ea ..... Service Manual

1 ea ..... Accessory Pouch

1 ea .....Torso/Respiration Patient Cable

2 Sets.....Electrode Wires, set of 3

1 ea ..... Mounting Adapter

1 ea .....Crt Scale Retainer

1 ea .....Detachable Power Cord

FUSES AND CAPS

115 V Range

1 ea .....Fuse, 0.5 A 3AG

1 ea ..... Fuse Cap for 3AG fuse

230 V Range

2 ea ..... Fuse, 0.3 A 5×20 mm

2 ea ..... Fuse Cap for 5×20 mm

SPECIFIED OPTIONAL ACCESSORIES

To ensure patient safety, use **only** accessories specified by Tektronix, Inc. A listing of accessories that are specified by Tektronix, Inc. for use with the 413A Monitor can be found in the back of the Operators Manual.

INSTALLATION

MOUNTING

The following accessories are available for mounting the 413A. See Figures 1-2 through 1-4.

MOUNTING

Includes Mounting Stand to mount monitor at five-foot level. Attaches to vertical pipes or surfaces of anesthesia machines or similar devices.

TEKTRONIX Part 016-0110-00.

MOUNTING BRACKET

Attaches to top of Mounting Stand. Mates with Mounting Adapter below.

TEKTRONIX Part 407-1797-00.

MOUNTING ADAPTER

Attaches to monitor. Mates with Mounting Bracket above. (Included with monitor as a standard accessory.)

TEKTRONIX PART 014-0054-00.

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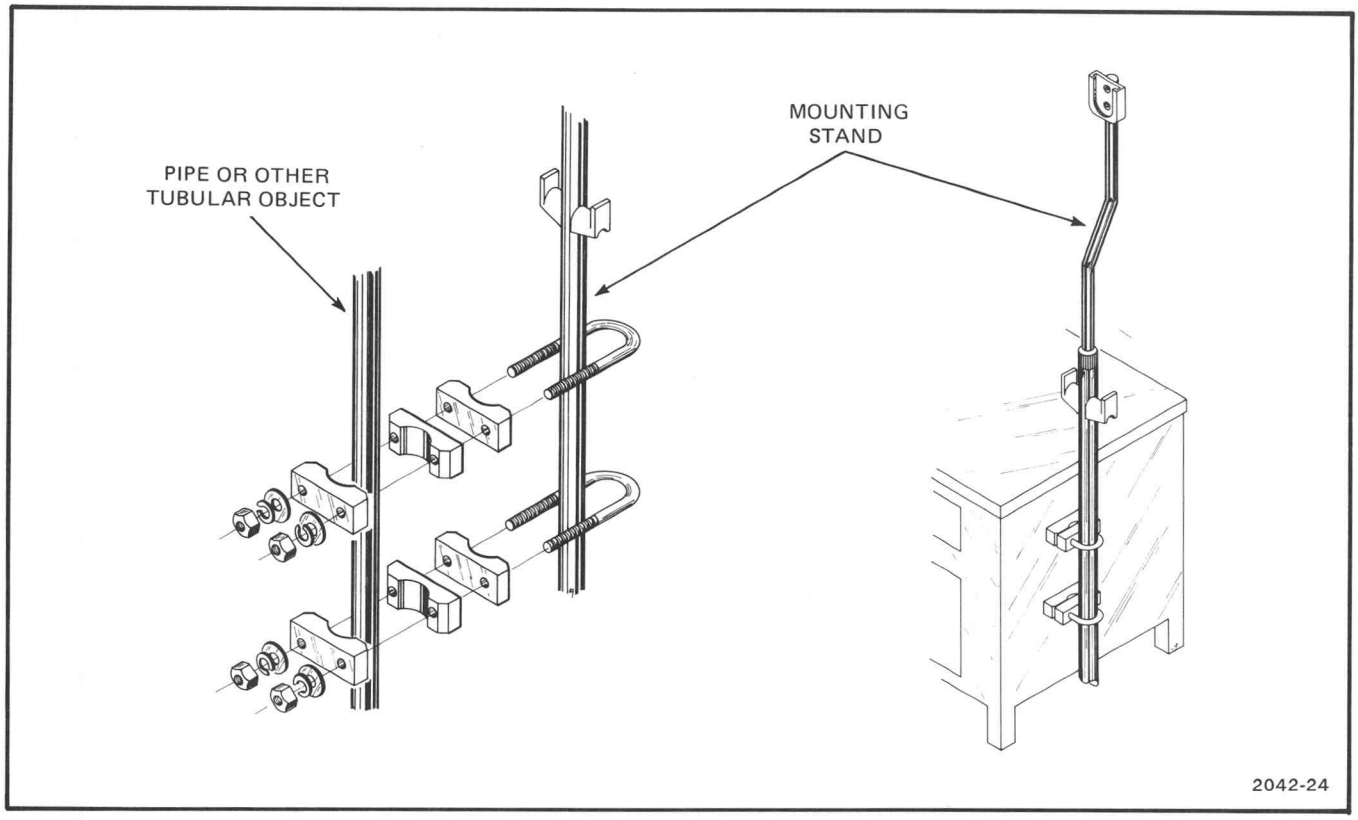

Fig. 1-2. Installing mounting stand to tubular object (pipe) or cabinet side.

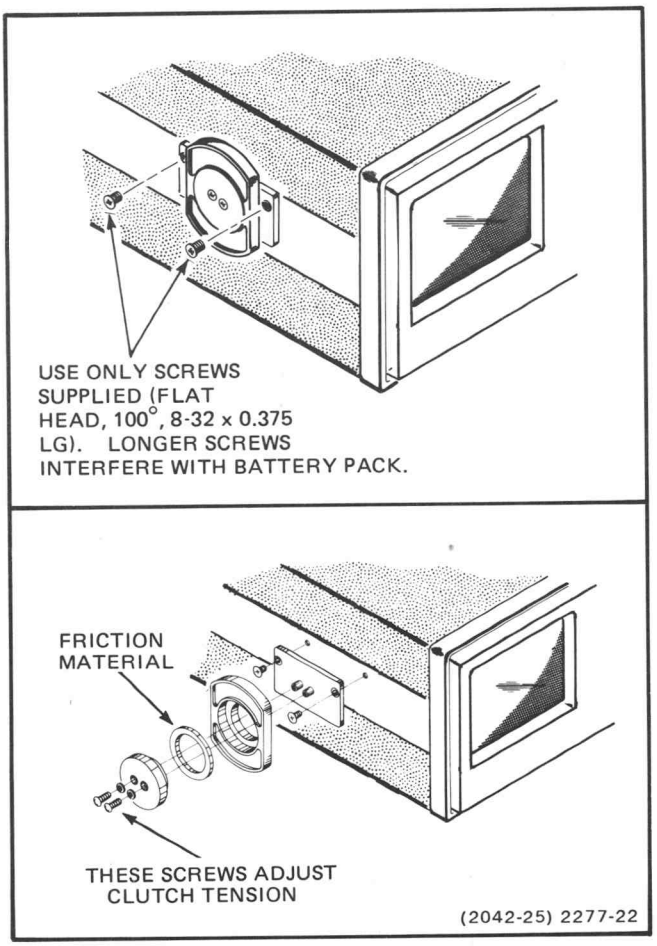

Fig. 1-3. Installing mounting adapter to monitor.

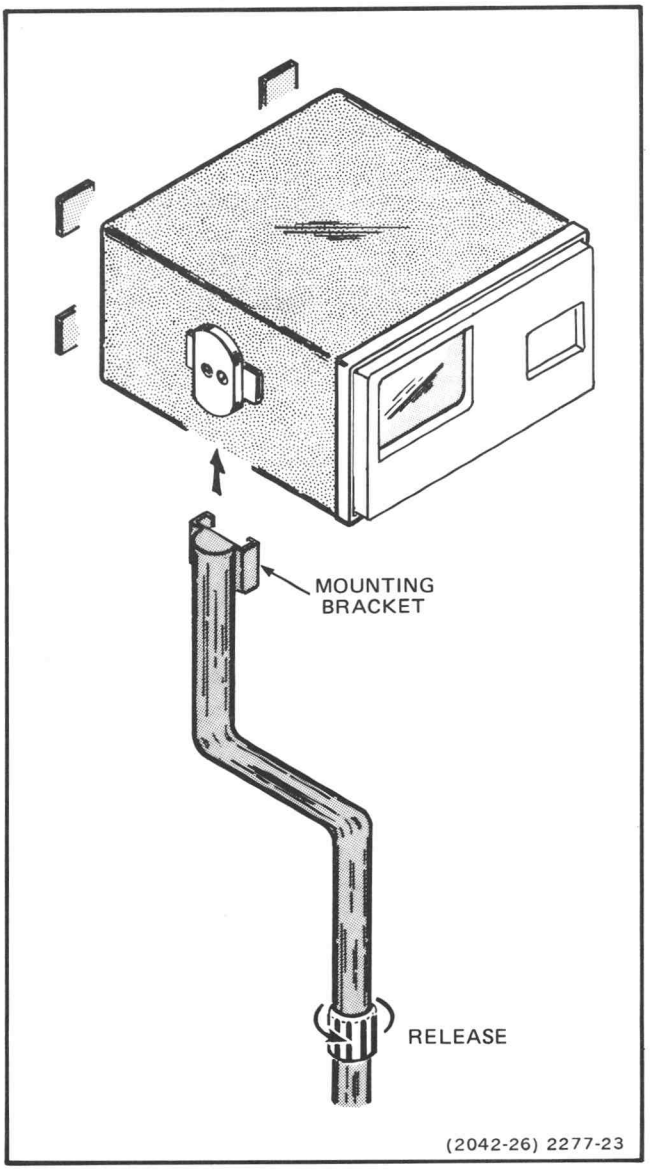

Fig. 1-4. Mounting monitor to mounting stand.

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OPERATING INFORMATION

POWER CONSIDERATIONS

MAINS POWER OPERATION

The 413A Monitor is designed for safe operation from either a mains power source or the internal battery pack. Battery operation has been provided primarily for monitoring patients during transport, but also provides uninterrupted monitoring during mains power failures.

NOTE

To ensure continued monitor operation during and after mains voltage transients (produced by electrical storms or automatic change over to/from emergency power systems) a charged battery pack must be installed. Check that BATTERY indicator is green when instrument is connected to mains power.

If mains voltage drops below about 98 volts for a sustained period of time, incomplete changevover to battery operation can eventually discharge the battery and cause uncalibrated operation (i.e., crt trace shrinking or digital readout errors). Calibrated operation can be restored for a time by disconnecting mains power cord. Be sure to reconnect power cord when mains voltage returns to normal.

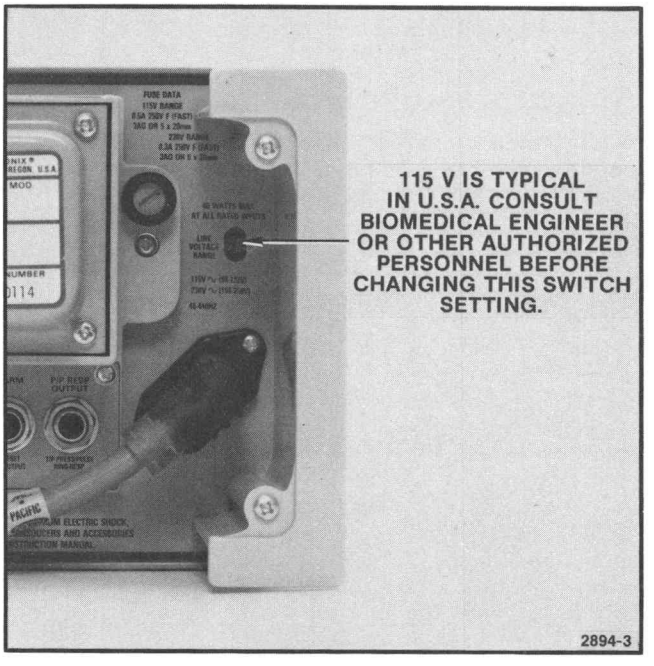

Fig. 2-1. Line-voltage switch (rear panel).

The monitor is shipped from the factory with the LINE VOLTAGE RANGE switch set at 115 and the correct "Hospital Grade" power cord set for operation (in the U.S.A) on 115 volt power lines (see Figure 2-1).

CAUTION

The monitor may be damaged if connected to a 230 volt source with the LINE VOLTAGE RANGE switch set at 115.

POWER SOURCE

The 413A is compatible with isolated power systems such as used in operating rooms.

Monitor Operation With Non-Isolated Power Systems

The monitor is intended for operation from single-phase earth-referenced power sources having one current-carrying conductor (the neutral or grounded conductor) near earth potential. Operation from power sources where both current-carrying conductors are live with respect to earth (such as phase-to-phase on a three-wire system) is not recommended, since only the line (or ungrounded) conductor has over-current (fuse) protection within the monitor.

POWER CORD AND PLUG

The monitor has a detachable three-wire (18-gauge, SJT-grade) power cord with a three-terminal polarized Hospital Grade plug for connection to the power source and protective ground. The protective-ground (earth) terminal of the plug is directly connected to the frame of the monitor.

WARNING

To avoid electric-shock hazard, insert this plug only in a mating "Hospital Grade" power outlet with a protective-ground contact. Do not defeat the grounding connection. Any interruption of the grounding connection can create an electric-shock hazard. Inspect the power cord periodically for fraying or other damage. Do not operate the monitor from mains power if the power cord or plug is damaged.

MAINS-CONNECTED INDICATION

The MAINS CONNECTED indicator should be lit any time that the power cord is connected to an active mains outlet. Make sure that this indicator is lit whenever you intend to operate from mains power or charge the battery pack. If this indicator is not lit when the mains power cord is properly connected to an active mains outlet, consult service person.

OVERLOAD PROTECTION

Fuse protection is provided for both 115 and 230 V mains operation (see Fig. 2-1). Check for an open fuse when an overload condition has occurred (MAINS CONNECTED indicator not lit when monitor is connected to active mains).

BATTERY OPERATION

Disconnecting the monitor from the mains outlet with the POWER switch pushed in (on) will automatically start battery operation. A correctly charged battery pack provides about 2.5 hours of operating time. The operating time varies with the functions used. See Table 2-2.

BATTERY STATUS

The color of the BATTERY condition indicator LED (light-emitting-diode, see Fig. 2-2) will change between red and green to indicate battery status. Refer to Table 2-1.

The BATTERY indicator does not function with the battery pack removed. If battery fuse, F1, (inside the battery pack or F4031 in the monitor power supply has blown, the BATTERY indicator will operate only when the mains power cord is connected.

The monitor will detect a low battery condition and shut off before the calibrated functions deteriorate; however, the monitor will operate on mains power regardless of battery condition. Plug the monitor into a mains outlet to use it and recharge the battery pack (see Battery Charging below).

BATTERY CHARGING

16 hours MINIMUM are required to recharge a depleted battery. Connect the power plug to a "HOSPITAL GRADE" power outlet. Longer charging time is required under certain circumstances. See Table 2-2.

Charge in a cool place; preferably no warmer than +22° C (≈+72° F). Higher temperatures prevent the battery from accepting maximum charge. Longer charging time will only partially compensate for a high temperature.

Maximum battery operating time is obtained when charging is done with the monitor turned off and in a cool place. With the monitor off, the internal temperature will be lower, allowing the cells to accept charge more efficiently.

TABLE 2-1
Battery Condition Indicator

BATTERY INDICATOR (LED) COLOR	BATTERY CONDITION
Green	indicates battery is charged (when operating on battery only), or charging when line cord is plugged into mains outlet.
Green and Red (Orange Hue)	Indicates battery is almost discharged, and approximately 15 to 30 minutes of use time remain.
Red	1. Indicates battery is discharged and monitor is about to shut down (when operating on batteries).
	2. Indicates defective battery or charger or open battery or power-supply fuses when power cord is plugged into ac outlet.

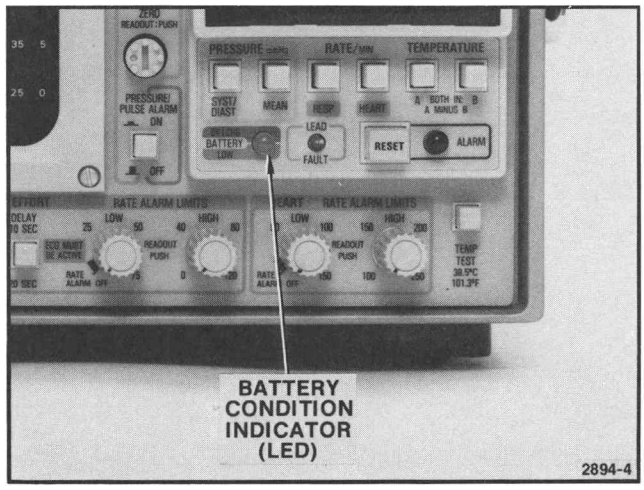

Fig. 2-2. BATTERY condition indicator (LED).

TABLE 2-2
Battery Charging and Operating Times

MONITOR TYPE	MINIMUM CHARGE TIME		TYPICAL OPERATING TIMES (All modes operating)[a]
	NOT OPERATING	FULLY OPERATING	
413A (only)	16 hrs	18 hrs	2.6 hrs
w/400 Rec. 4 record cycles/hr	--	20 hrs	2.5 hrs
20 record cycles/hr	--	26 hrs	2.3 hrs
w/401 DRM	16 hrs	50 hrs	1.9 hrs
w/400 & 401	16 hrs	[b]	1.8 hrs[c]

[a] Operating times listed are for new battery packs which have been charged while monitor is not operating. For battery packs charged while monitor was operating, reduce listed times by about one third.

[b] Monitor can be operating, but either or both the 400 or 401 must be turned off for charging to take place.

[c] With recorder producing four 14-second samples per hour.

Avoid excessive charging. If the monitor is not being used, turn it off. Unplug it from the power outlet when the battery is fully charged.

The battery will gradually discharge itself over a two to six month period and will, therefore, require recharging when it is again placed into use.

Certain applications, such as use in Intensive Care, may require continuous use and, therefore, will require the monitor to be continuously connected to a mains outlet. Weeks or months of excessive charging result. **When next used on battery, the operating time may be SIGNIFICANTLY less than the listed typical amount.**

Battery Operating Time Test

Occasionally check operating time as follow:

1. Charge fully. See Table 2-2.
2. Operate monitor on battery until automatic shutdown occurs.
3. Note the operating time.

If the operating time is significantly less than listed on the chart and becomes, therefore, unsuitable for your application, condition the battery as explained below.

BATTERY CONDITIONING

The battery conditioner deep discharges the cells to restore original charge capacity. To condition battery:

1. Connect mains power cord.
2. Turn monitor power off.
3. Momentarily push Battery Conditioning START button on the left side of the monitor. The START button should light up indicating that the conditioning cycle is in progress.
4. When the light goes out (anywhere from a few minutes up to up to 8 hours depending on condition) the normal charge cycle has begun. At this time the monitor can be operated on mains power, if necessary. Be sure to allow sufficient time to fully recharge the battery (see Table 2-2).

FUNCTIONS OF CONTROLS, CONNECTORS, AND INDICATORS

FRONT PANEL (Fig. 2-3 & 2-4)

1 **MONITOR ON/OFF.** This pushbutton switch turns the monitor on or off. The battery charger operates continuously as long as the monitor is connected to a mains power source. When the 413A Monitor has a 401 Digital Readout Module attached, the net battery charging current is reduced during 401 operation (MONITOR "ON" and READOUT MODULE "ON") because the 401 draws its power directly from the monitor battery.

2 **MAINS CONNECTED.** This indicator lights when power cord is connected to an active mains outlet and primary circuits are intact (no blown fuses).

3 **BEAT LOUDNESS.** This control adjusts the loudness of the beat tone and should be set fully clockwise if maximum loudness is desired. The tone is heard once for each QRS pulse during ECG use, or once for the leading edge of each pulse waveform during pulse operation (or pressure waveform in the pressure mode of operation).

4 **SWEEP SPEED mm/SEC.** Four pushbuttons select the speed of the trace across the screen. The sweep speeds are 12.5, 25, 50, or 100 mm/SEC. The total time it takes the trace to cross the screen is 8, 4, 2, or 1 second(s), respectively.

5 **RESPIRATORY EFFORT ARREST ALARM and DELAY.** When the ARREST ALARM button is pushed, it activates alarm circuitry which senses inadequate respiratory effort. (Circuitry is also provided as a part of the respiratory effort channel to reduce chances of cardiovascular artifacts being sensed as inspirations). The DELAY switch selects between 10 and 20 second delays. This Alarm will also be activated if the ECG rate falls below about 60 beats/min.

6 **HEART RATE LIMITS.** Source for the HEART RATE ALARM is the ECG channel when it is turned on. If the ECG channel is turned off, the source is the Pressure/Pulse channel.

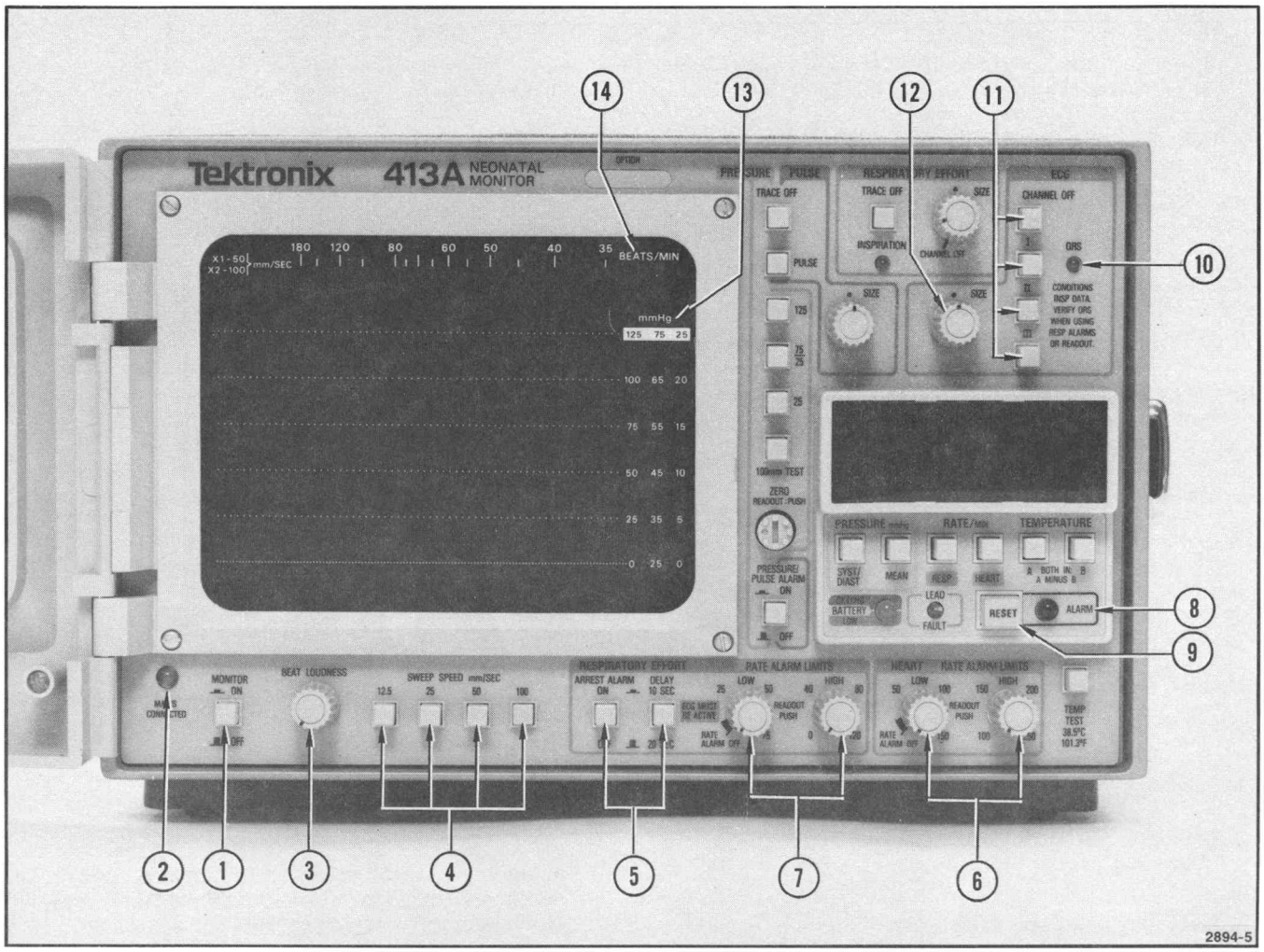

Fig. 2-3. Front-panel controls and indicators (1 through 14).

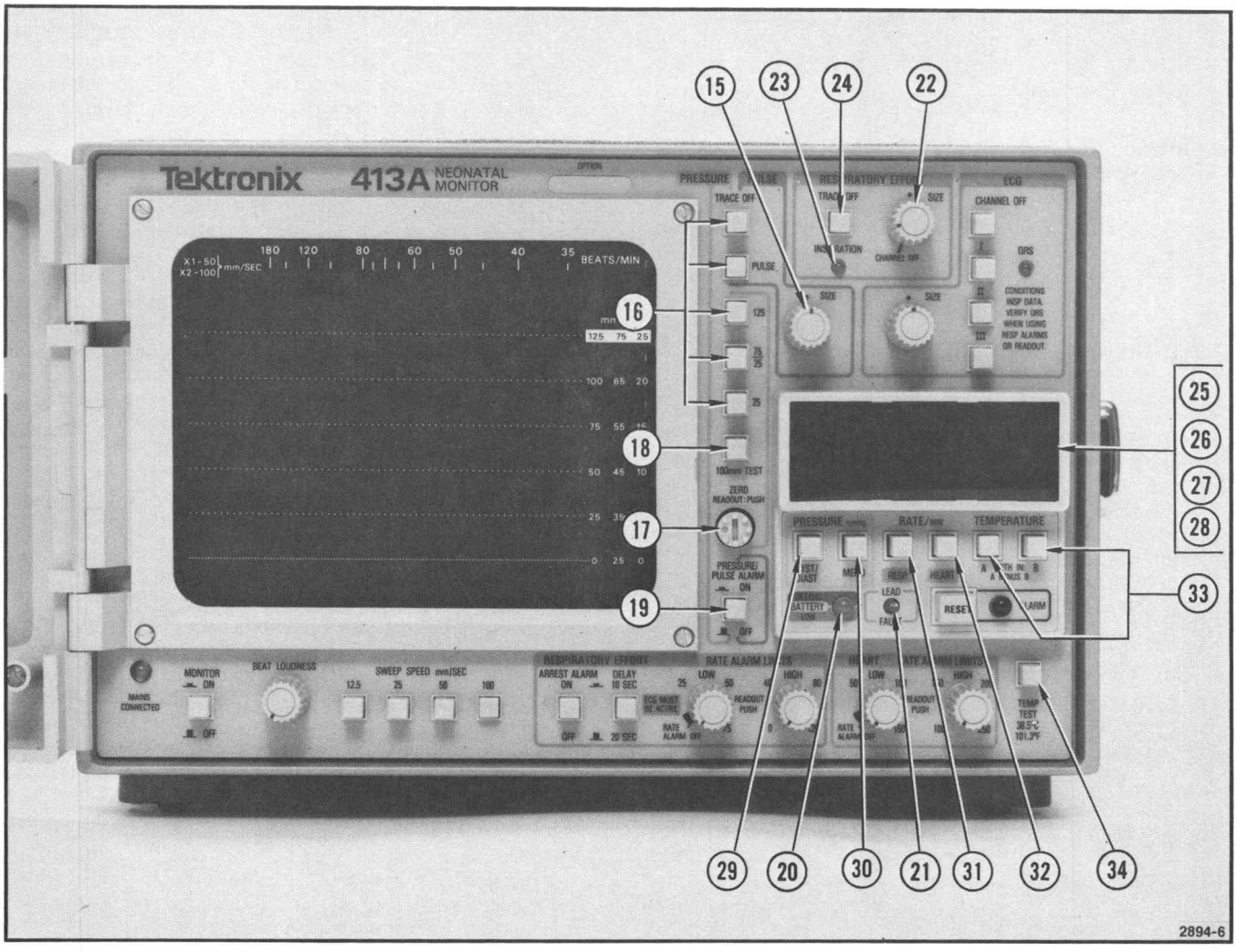

Fig. 2-4. Front-panel controls and indicators (15 through 34).

LOW. This control sets the lower heart rate alarm limit between 0 and 150 bpm. For more accurate settings, push the control while adjusting for the desired value on the digital display. This control also disables the heart-rate alarm when in the ccw detent position, marked RATE ALARM OFF.

HIGH. This control sets the upper heart-rate alarm limit between 100 and 250 bpm. For more accurate settings, push the conrol while adjusting for the desired value on the digital display.

7 RESPIRATORY EFFORT RATE LIMITS.

LOW. This control sets the lower respiratory effort rate limit between 0 and 75 breaths per minute. For more accurate settings, push the control while adjusting for the desired value on the digital display. This control also disables the respiratory effort rate alarm when in the ccw detent position, marked RATE ALARM OFF.

HIGH. This control sets the upper respiratory effort rate limit between 0 and 120 breaths per minute. For more accurate setting, push the control while adjusting for the desired value on the digital display.

This alarm will also be activated if the ECG rate falls below about 60 beats/min.

8 ALARM. This indicator flashes (and audio alarm sounds) when an alarm violation occurs. Light continues flashing after RESET is pushed if violation has not cleared.

9 ALARM RESET. When an alarm violation occurs, the alarm light flashes and the audio alarm sounds. If the RESET button is pushed while an alarm violation still exists, the ALARM light continues flashing and the audio alarm is turned off. If the alarm violation is remains after about 45 seconds the audio alarm will sound again. Momentarily pressing the RESET button in this timing interval

resets the time to 45 seconds. If the alarm violation clears while the audio alarm is temporarily off, the ALARM light turns off and the audio alarm does not come back on.

Pushing RESET anytime during a violation begins the 45 second delay over again.

If the alarm condition clears while the audio alarm is sounding, the audio alarm clears and the ALARM light continues flashing until RESET is pushed.

10 **QRS.** This green LED flashes each time a QRS complex is detected in the ECG.

11 **ECG.** Pushbuttons control the lead selection for ECG. They are I (RA to LA), II (RA to LL), and III (LA to LL). These pushbuttons control the display on the upper half of the screen (when any combination of the PRESSURE, PULSE, or RESPIRATORY EFFORT channels is also displayed). If only ECG is on, the display will move to the screen center. The CHANNEL OFF pushbutton turns off the ECG channel.

12 **ECG SIZE.** This control varies the amplitude of the ECG waveform display. The rear-panel ECG OUTPUT signal is not affected by the SIZE control.

13 **Pressure Scales.** Three pressure scales corresponding to the selectable ranges are printed on the right side of the crt graticule.

14 **BEATS/MIN Scale.** The BEATS/MIN scale is used with the 50 mm/SEC and 100 mm/SEC SWEEP SPEED. The scale shows the correct display multiplier for the sweep speed selected. This scale is not usable on the 12.5 mm/SEC, or 25 mm/SEC sweep speeds since the sweep is not synchronized at those speeds. A spot will appear on the left edge of the display. This is the starting point of the sweep, which has been reset and is awaiting the next synchronizing event. Any vertical movement of this spot is an accurate indication of the events prior to sweep start.

15 **PULSE SIZE.** This control varies the amplitude of the pulse display when the pulse mode of operation is being used. The signal at the PRESSURE/PULSE (P/P) OUTPUT connector varies in proportion to the displayed pulse signal. Small signals (one-half division of display or less) may not cause a beat tone and may set off the pulse alarm or the rate alarm (when the ECG channel is off and the pulse channel is providing the beat information). Display amplitudes that go off the screen may cause extra beats to be heard. Adjust the PULSE SIZE control for a two-to-three-centimeter display where possible.

16 **PRESSURE/PULSE.** Five pushbuttons control the pressure or pulse display. They are TRACE OFF, PULSE, 125, 75/25, and 25. PULSE permits the display from a pulse sensor to appear on the screen and turns off the pressure channel. TRACE OFF turns off the pressure/pulse waveform display; however, the digital display can monitor the pressure/pulse channel regardless of the TRACE OFF pushbutton setting. The 125, 75/25, and 25 pushbuttons select the mmHg (millimeters of mercury) range for the pressure display. Small pulsatile pressure signals (one-half division of display or less) may not cause a beat tone. Display amplitudes that go off the screen may cause extra beats to be heard (when the ECG channel is off and the pressure/pulse channel is providing the beat information). Select the appropriate pressure range. Pressure readout is blanked when a pressure transducer is not connected or when PULSE button is in. Crt pressure display is turned off if there is no transducer connected. Also, see PRESSURE/PULSE ALARM control information.

17 **ZERO.** This control permits establishment of a zero-pressure reference, and is adjustable with finger tip or screwdriver. Pressing in while rotating the control provides a fast, accurate indication of offset on the digital display. This control has a coarse-fine feature which allows coarse and fine adjustment over a wide range of pressure transducer offset values.

18 **100 mm TEST.** Usable only with standardized pressure transducers containing a calibration resistor. With such a transducer connected to the monitor, this pushbutton displays a 100 mmHg test signal each time it is pressed. Since 100 mmHg is off screen on the 25 and 75/25 mmHg pressure scales, the crt display can be checked only with the 125 mmHg scale. The digital display can be checked with any pressure range button pressed. There is no display change when a transducer without a calibration resistor is used. A mean pressure reading of between 95 and 105 mmHg is expected on on the digital display when pressure input to the transducer is zero, the ZERO control is properly set, and the 100 mm button is pushed.

19 **PRESSURE/PULSE ALARM.** Activates alarm if the pulsatile pressure or pulse signal falls below a certain limit. For pressure, this minimum value is 5-10 mmHg and can indicate a broken, plugged, dislodged, or constricted catheter. For pulse, the minimum value is about one-half cm of display and can indicate a loss of peripheral circulation (e.g., in great toe during catheterization of femoral artery). Alarm is inhibited when switch is in the out position.

20 **BATTERY.** This LED (light emitting diode) changes color from green to orange to red to indicate the approximate state of charge of the battery pack. Refer to Table 2-1.

21 **LEAD FAULT Indicator.** This LED responds to information from either ECG or Respiratory Effort channel. Activation from the ECG channel indicates loss of effective ECG amplifier input connection to the patient. Activation from the Respiratory Effort channel indicates unsuitable condition in LA to RA lead/electrode system for respiratory effort monitoring. This light indicates the following possible problems:

a. An open circuit (break) in the patient cable, the electrode wires, or the electrodes.

b. Poor contact to patient due to insufficient gel or paste on the electrode(s).

c. One or more electrodes or electrode attachment wires disconnected.

d. No button pushed in on the ECG switches.

e. Two or more buttons pushed in on the ECG switches.

f. Excessive dc offset due to dissimilar metals, etc., between the electrodes.

22 **RESPIRATORY EFFORT SIZE.** This control varies the height of the respiratory effort display when the RESPIRATORY EFFORT channel is being used. The RESPIRATORY EFFORT channel can be disabled by rotating the SIZE control fully counterclockwise into the detent (CHANNEL OFF) position.

23 **INSPIRATION.** This LED lights when chest expands with each draw of breath and can also be seen on the respiratory effort waveform display as the rising portion of each wave. When a CVA condition is sensed the INSPIRATION light does not respond.

24 **RESPIRATORY EFFORT TRACE OFF.** Turns off the RESPIRATORY EFFORT waveform display; however, the digital display will monitor the respiratory effort rate (with RESP pushbutton depressed) regardless of the TRACE OFF pushbutton setting.

25 **Digital Display.** Provides digital display of pressure (mmHg), respiratory effort rate (breaths per minute), heart rate (beats per minute), temperature (°C or °F), rate limits setting, or pressure ZERO adjustment knob setting. Polarity is indicated automatically to aid in setting of transducer zero and for reading negative pressure. Readout display flashes to indicate overrange, and is blanked if the function selected is invalid or if all the pushbuttons are out. LED's indicate display units: °C, °F, mmHg (mm), or rate/min (/m).

Digital Readout Units Indicators

26 **/m.** Lights to indicate units of rate (per minute) when respiratory effort or heart rate are selected as the source of the digital display; it lights even if digital display is blanked. It also lights when RATE LIMIT controls are pushed.

27 **mm.** Lights to indicate units of pressure (mmHg) when pressure is the selected source of the digital display;it lights even if the digital display is blanked. It also lights when the pressure ZERO control is pushed.

28 **°C or °F.** Lights to indicate the selected scale (Celsius or Fahrenheit) when temperature is the selected source of the digital display; it lights even if the digital display is blanked).

Digital Readouts

29 **SYST/DIAST.** Digital readout display alternates between systolic and diastolic values expressed in millimeters of mercury (mmHg). A blank period preceding the systolic readout aids recognition. The complete readout cycle takes about 3 seconds; the PRESSURE/PULSE TRACE OFF pushbutton can be in or out.

30 **MEAN.** Digital readout displays arithmetic mean of pressure signal in mmHg. The PRESSURE/PULSE TRACE OFF pushbutton can be in or out.

31 **RESP RATE/MIN.** Digital readout displays respiratory effort rate in breaths per minute. Signal source is from Respiratory Effort channel. Readout is blanked when Respiratory Effort channel is turned off.

32 **HEART RATE/MIN.** Digital readout displays heart rate in beats per minute. Signal source is ECG when ECG is on. When ECG is off, either pressure or pulse provides the rate information.

33 **TEMPERATURE.** Select either the A or B temperature probe for individual temperature readout displays. Press both A and B pushbuttons together for a difference (A–B) readout display. Displays temperature in °C or °F as selected by the rear-panel switch. Resolution is 0.1°. Use only dual-thermistor Yellow Springs Instrument Co. 700 series probes. Probe faults such as shorts, opens, or partial insertion in the monitor cause the display to blank or flash.

34 **TEMP TEST.** Pushing this button causes the digital display to readout a simulated temperature value of 38.5° C or 101.3° F. This allows verification of temperature channel calibration accuracy. Display should read within 0.2° C or 0.3° F.

RIGHT-SIDE PANEL (Fig. 2-5)

35 ECG/RESP LEAD TEST. These three terminals provide a test signal for checking cable, electrode or electrode wire defects, and ECG/Respiratory effort circuit operation. When the patient wires are connected to the ECG/RESP LEAD TEST terminals, an ECG lead selector button is pushed in, and the ECG SIZE and RESPIRATORY EFFORT SIZE controls are centered (on midrange mark), the display should be:

PARAMETER SELECTED	DISPLAY
ECG Lead I	20 mm of positive-going signal at 117 bpm.
ECG Lead II	30 mm of positive-going signal at 117 bpm.
ECG Lead III	10 mm of positive-
Respiratory Effort	10 mm tilted squarewave at 29 breaths/min. Amplitude of waveform is measured at squarewave leading or trailing edge.

Inspiration and QRS indicators should be flashing, and audio beat tone should be heard (set BEAT LOUDNESS to desired level). Allow 30 seconds and 10 seconds, respectively, for inspiration and QRS signal acquisition.

If the LEAD FAULT indicator lights, the cable or electrode wires may be defective.

LEFT-SIDE PANEL (Fig. 2-6)

36 Battery Conditioner START. Starts a battery conditioning cycle that discharges and recharges the F cells to restore original battery capacity.

REAR PANEL (Fig. 2-7)

37 ALARM LOUDNESS. Adjusts the loudness of the audible alarm signal. Set fully clockwise if maximum loudness is desired. Set control fully counter clockwise to obtain a low-level audible alarm.

38 TEMPERATURE SENSOR INPUTS. Connect only Yellow Springs Instrument Co. 700 series dual-thermistor temperature probes. The two temperature inputs may be utilized individually (INPUT A or B) for separate temperature measurements, or together (both INPUTS A and B) for difference temperature measurements, as selected on the front panel.

39 °C/°F. Switch selects temperature scale for both temperature channels.

40 GND. Provides an additional grounding point (there is one in the power cord) for the instrument case. When the power cord is not connected to a power source, the case should be grounded using the GND. This provides added protection against any voltage source, which may contact the case, from reaching the patient. Grounding through the power cord requires an appropriate three-wire outlet. Do not use a three-terminal to two-terminal adapter. See Safety Summary in front of this manual.

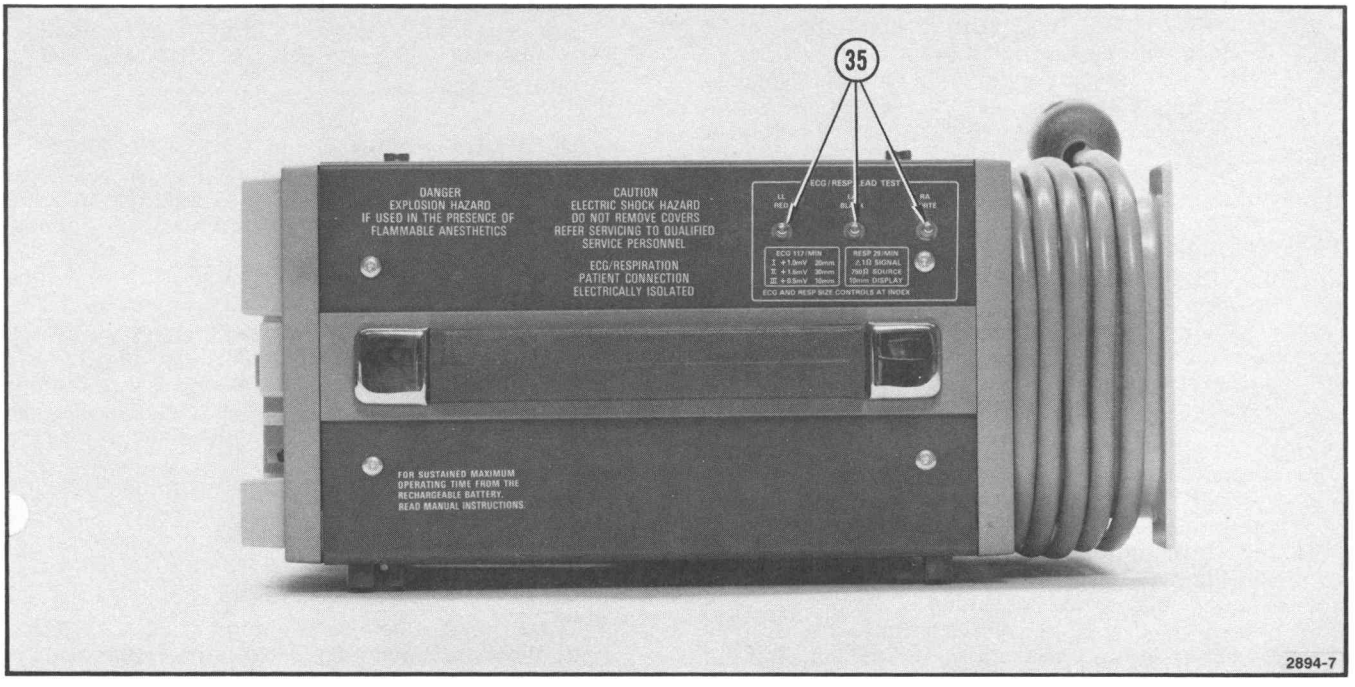

Fig. 2-5. Side-panel ECG/RESP LEAD TEST terminals.

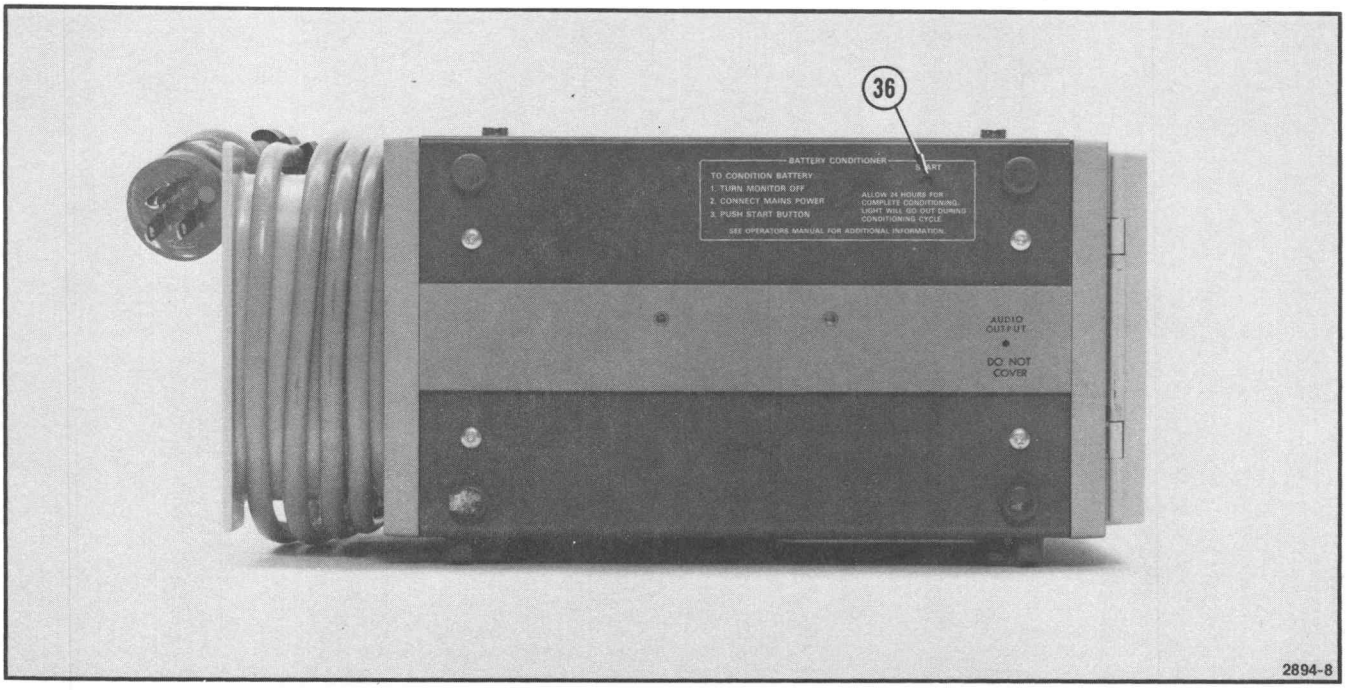

Fig. 2-6. Left-side panel battery conditioner START button/indicator.

41 ECG/RATE OUTPUT. Provides two output signals through a stereo phone jack. The tip is the ECG signal times 1000. The ring is the heart rate trigger signal.

42 ALARM. Provides for remote indication and resetting of alarms through a stereo phone plug. Shorting the phone plug tip to the barrel (ground) resets the alarm (providing the alarm violation has been corrected). The ring provides a 12 mA signal to indicate an alarm condition.

43 P/P RESP OUTPUT. Provides two output signals through a stereo phone plug. The tip provides a pressure/pulse output of 0.5 volt for each centimeter of displayed signal. The ring provides a respiratory effort signal output of 0.5 volt per centimeter of displayed signal on the screen.

44 Mains Power Cord and Plug. Detachable power cord permits connection to the power line for ac operation and battery charging.

45 LINE VOLTAGE RANGE. This switch is a screwdriver-operated slide switch. It must be set to indicate the proper nominal mains voltage (115 or 230 V ac). The corresponding fuse value must be used.

46 Line Fuse(s). Provides fuse protection for 115 and 230 Vac operation. In the European Model, two line fuses provide protection in both sides of mains. Either 3AG or 5 x 20 mm style fuses are accommodated using fuse caps supplied.

47 PULSE SENSOR INPUT. Permits connection of the pulse sensor cable to the instrument.

48 PRESSURE TRANSDUCER INPUT. Permits connection of the pressure transducer cable to the instrument.

49 PATIENT CABLE INPUT. Permits connection of the ECG/respiratory effort patient cable to the instrument.

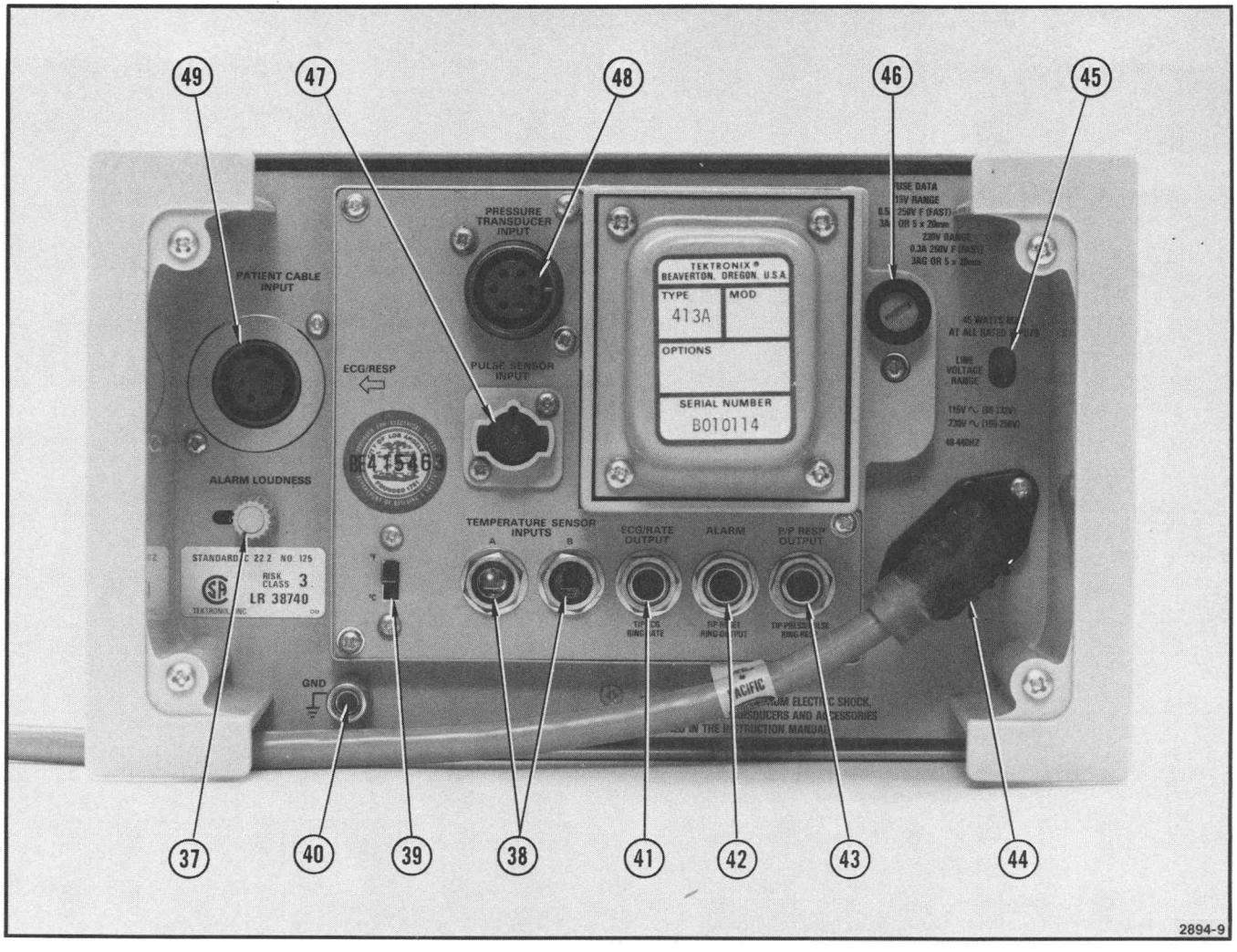

Fig. 2-7. Rear-panel controls and connectors.

THEORY OF OPERATION

This section describes the operation of the circuits in the 413A Monitor.

In general, most circuitry is confined to 11 circuit boards. The Main board, which is the largest, is mounted horizontally on the lower part of the monitor and contains Trace Chopping, Vertical Amplifier, Sweep Trigger, Sweep Generator, Horizontal Amplifier, Audio Amplifier, Power Supplies, Master Clock and Battery Charger circuitry. Five boards (ECG, Respiration, Pressure/Pulse, DVM, and High-Voltage) are plugged on top of the Main board. The Conditioner board is plugged on the bottom of the Main board. The remaining three boards (Readout Switch, Sweep Switch, Rate Alarm Control, and Digital Display) are mounted to the front subpanel. (Three additional boards are contained in the battery conditioner pack.)

The QRS-beat and alarm speaker is located inside the left-side frame, near the front of the monitor. The power transformer, with all other ac-line-voltage circuitry, is mounted to the rear panel.

The Functional Block Diagram, in the Diagrams and Circuit Board Illustrations section, shows major circuit and signal flow and can be used to get a general overall understanding of circuit relationships. Detailed schematics of each circuit are also located in the Diagrams section at the back of this manual. Refer to these schematics throughout the following circuit description for specific electrical values and relationships.

ECG BOARD

ECG BOARD CIRCUIT FUNCTIONS

The ECG circuit (Figs. 3-1 and 3-2) accomplishes the following:

1. Amplifies the ECG signal (three input lead configurations). The circuit provides extremely low-leakage isolation between patient and monitor. The input circuitry is protected for use during defibrillation and electrocautery.

2. Indicates when a fault exists in ECG input cables, wires electrodes, etc.

3. Provides ECG output signals to a rear-panel jack. Output amplitude is fixed at ×1000 of the input signal.

4. Provides an amplified ECG display signal, whose amplitude is variable with the ECG SIZE control. When only the ECG channel is on (single trace), the display baseline is positioned to the screen center. When the pressure/pulse and/or respiration channel is also displayed the ECG display baseline is positioned about 2 centimeters above the screen center.

5. Provides a logic signal to indicate whether the ECG channel is off or on. The signal goes to:

   a. The Main board to allow display of this channel either in single or multi-trace depending on the status of the pressure/pulse or respiration channels.

   b. The Main board to select the trigger source, either from the ECG channel (ECG on) or from the pressure/pulse channel (ECG off).

   c. The Pressure/Pulse board to set the pulse display baseline at the screen center for pulse only, or about 2 centimeters below screen center when both pulse and ECG are selected.

   d. The Respiration board to set the respiration display baseline at the screen center, 2 centimeters below screen center, or 2 centimeters above screen center, depending on the status of the ECG, pressure, or pulse channels.

6. Provides an ECG (QRS) trigger to the Main board for digital display of heart rate, sweep triggering, beat tone, analysis of heart rate alarm conditions, and to the RATE OUTPUT connector on the rear panel.

ECG AMPLIFIER CIRCUIT OPERATION

The ECG signal enters the Floating Input Amplifier (Fig. 3-1) through three electrode wires. One of the wires is the signal reference and the other two are used for a differential input signal. The ECG pushbuttons are used to select any pair of wires as the input signal. Respiration signal is picked off through T3000 from leads RA and LA.

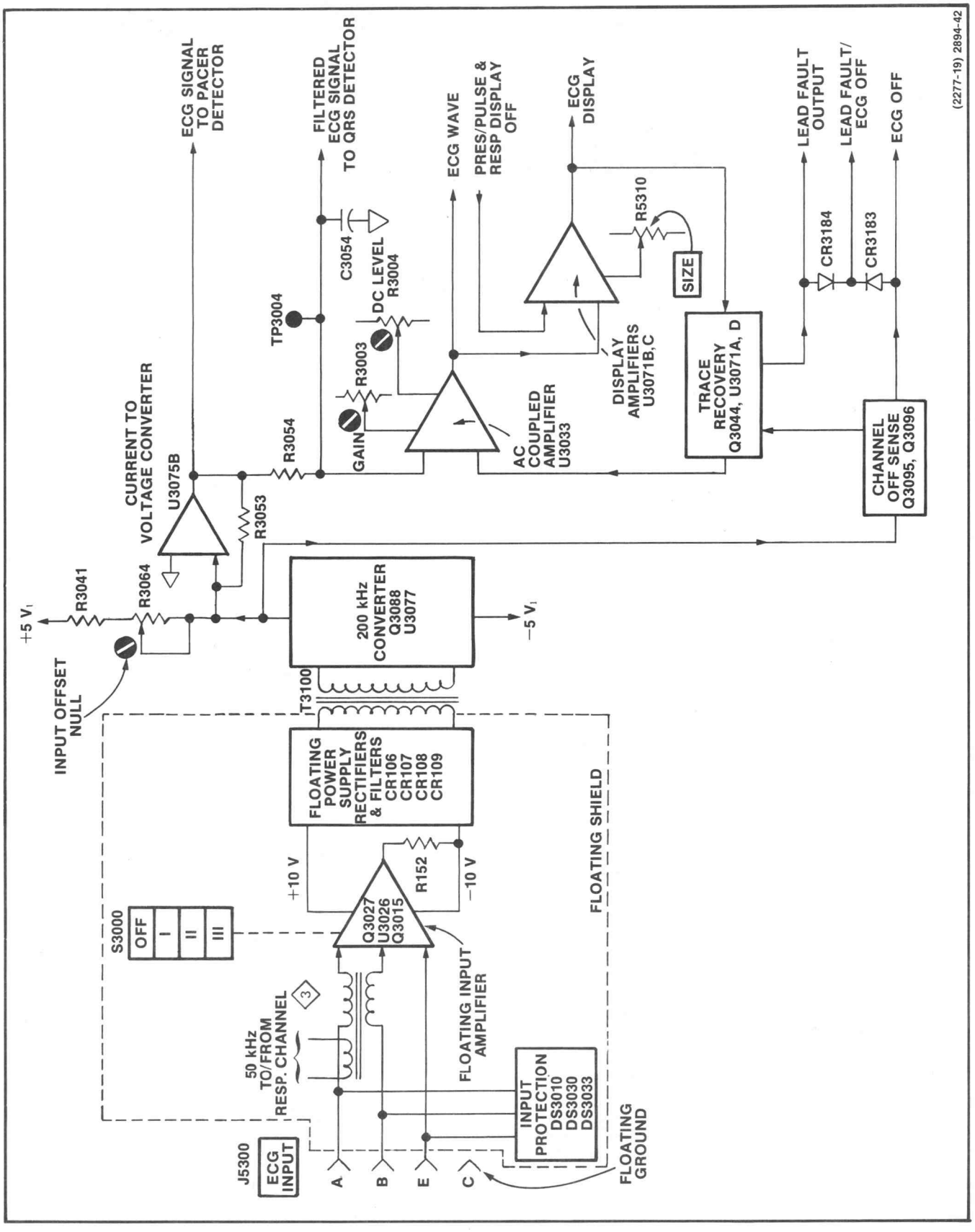

Fig. 3-1. ECG amplifier block diagram.

The ECG patient cables contain a resistor in series with each input wire. These resistors, and the input protection circuit, protect the Floating Input Amplifier during defibrillation and electrocautery.

A very small amount of current (1 nA) is injected into the patient electrodes. When this current is interrupted in an active input wire (as when a wire breaks), the LEAD FAULT indicator lights (may not light when only the reference lead has opened).

The input amplifier is isolated from the other circuitry and from the monitor chassis. The shield covering the Floating Input Amplifier circuitry and the shield in the patient cable are connected to the floating ground point to reduce ac interference.

The Floating Power Supply provides the power for the Floating Input Amplifier through transformer T3100. The circuit is designed so that the amplified ECG signal varies the load on the transformer, causing the supply current to change. This changing current becomes an amplified voltage signal at the output of the Current-to-Voltage Converter.

The Current-to-Voltage Converter provides ECG signals to the Pacer Detector and QRS Detector, and the input signal to the Ac-Coupled Amplifier.

The Ac-Coupled Amplifier provides the remainder of the needed gain and determines the high- and low-frequency response of the ECG channel. Gain and dc level are set by the two calibration adjustments in this circuit. Output of this amplifier provides the ECG output to the rear panel and the input to the Display Amplifier.

In the Display Amplifier, ECG-display-signal amplitude can be varied with the SIZE control. This control does not change the ECG-output-signal amplitude to the rear panel. A logic signal, from the Pressure/Pulse board, positions the ECG-display baseline for single or multi-trace operation.

FLOATING POWER SUPPLY

Two comparators (U3077A and B) are driven by the 200 kHz clock signal from the Main board. The complementary outputs of the comparators drive the gates of Q3087 and Q3088. Only one of these FETs is on at a time. The outputs of U3087 and U3088 drive transformer T3100. C3043 and R3043 provide a shunt load to prevent transients on terminals 1 and 3 of T3100 when the corresponding transistor (Q3087 or Q3088) turns off (the transients can produce noise on the ECG trace). Transformer T3100 is insulated for at least 5 kV to allow the secondary circuit to operate with its floating ground at ±5 kV dc with respect to chassis ground.

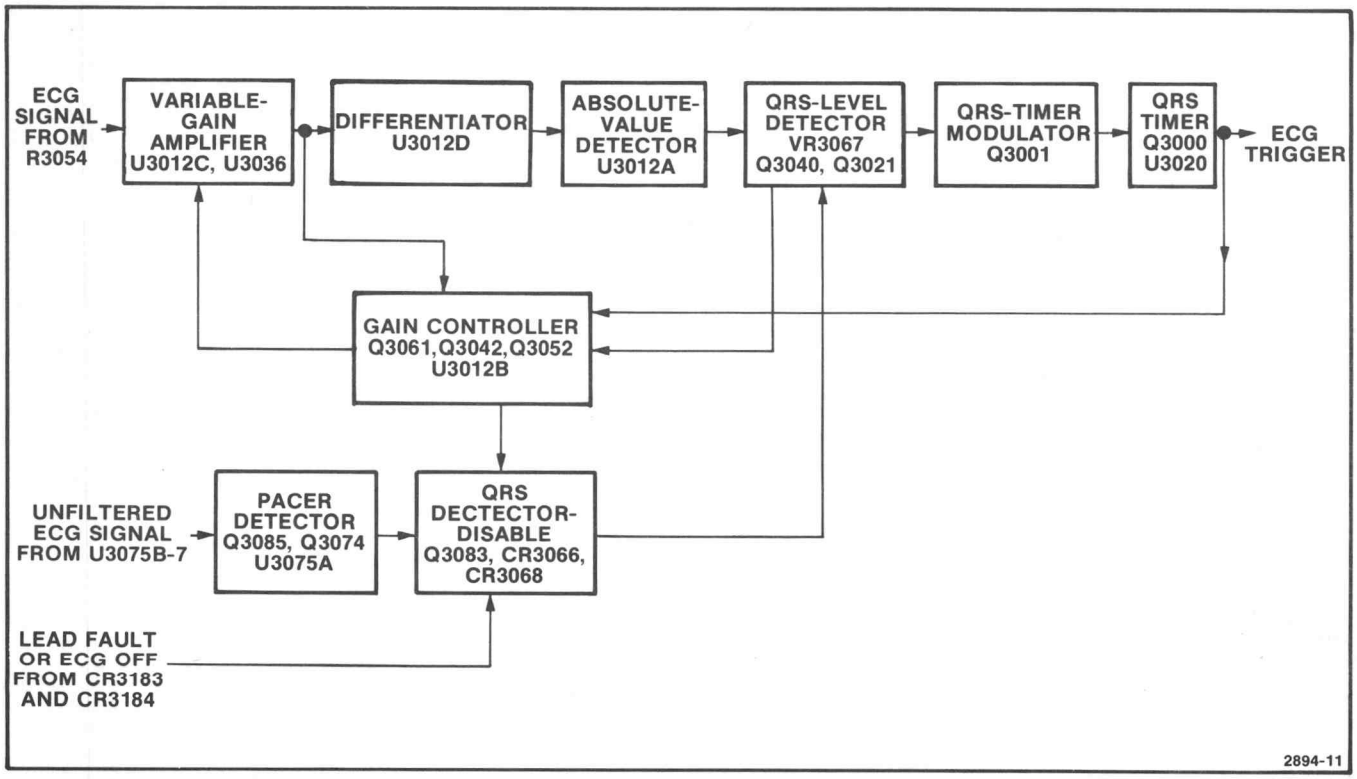

Fig. 3-2. QRS detector block diagram.

FLOATING INPUT AMPLIFIER

Circuit protection is provided against excessive input voltages to the input amplifier during electrocautery and defibrillation. Input voltage is limited by DS3010, DS3080, DS3033, R3015, R3035, CR3014, CR3015, CR3034, CR3035, VR3020, VR3021 and the 1 kΩ resistors in series with each lead in the patient cable. Capacitors C3010, C3030, and C3033 reduce radio-frequency interference from TV and radio signals and electrocauterizers. Resistors R3015 and R3035 limit maximum available current to provide patient protection in case of circuit failure. Resistors R3014 and R3034 supply about 1 nanoampere of current to the active patient electrodes. If this current is interrupted (wire breaks or high electrode resistance), the display will shift off screen and the LEAD FAULT indicator will light.

The input Amplifier is a differential-input, single-ended output circuit consisting of balanced transistors Q3027A and Q3027B and output amplifier U3026B. The output of U3026B varies the current through R3037 in proportion to the ECG input signal. The differential gain of the amplifier is determined by feedback dividers R3019/R3022 and R3037/R3038. The gain at TP3016 is about 9.5 times the input signal.

U3026A maintains the junction of R3022 and R3037 at 0 volts (referenced to the floating ground), which permits R3024 to set a constant current through Q3027A and Q3027B, reducing the ac common-mode signals to a very low level.

When no signal is applied, there should be about 0 volts at TP3016 with respect to the floating ground and R3020 current is about 5 mA.

R3020 current comes from the 10 V supply, through U3026B and to the -10 V supply. When a signal enters the input amplifier, the current through R3020 increases or decreases changing the load on the 200 kHz Converter.

CURRENT TO VOLTAGE CONVERTER

Feedback action of U3075B maintains 0 volts at pin 2 of T3100, by way of R3053. Input Offset Null (R3064) is adjusted so that pin 2 of T3100 is 0 volts when no signal is applied to the ECG INPUT.

The ECG signal current in R3020 unbalances the current in the floating supplies. This unbalance attempts to shift the dc level at pin 2 of T3100. In order to maintain pin 6 of U3075B at 0 V, U3075B provides current through R3053 to cancel the unbalance. This current develops a voltage across R3053 which corresponds to the ECG input signal.

The gain at U3075B-7 with respect to the signal at TP3016 is determined by the turns ratio of R3100, and the ratio of R3053 to R3020. The resulting gain from the eletrodes to TP3004 is about 20.

R3054 and C3054 filter most of the 200 kHz hash from the signal. Remaining hash is removed by the Ac-Coupled Amplifier.

AC-COUPLED AMPLIFIER

U3033 and associated circuitry make up a special form of non-inverting amplifier with upper and lower bandwidth limits.

Short-duration overdrive signals will not shift the display baseline significantly because ac-coupling capacitor C3140 is in the feedback circuit.

The X50 amplifier gain is determined by R3137, R3136, R3139, R3003 (Gain) and R3143. High-frequency bandwidth is determined by R3137, R3136, and C3138. Low frequency bandwidth is determined by C3140, R3140, and R3141.

R3137 and R3136 limit the input dynamic range of the amplifier to ±7.5 V, corresponding to a ±375 mV dc offset at the ECG INPUT connector. This causes the LEAD FAULT indicator to be on when the input dc offset exceeds the ±375 mV limit.

DISPLAY AMPLIFIER

The ×1000 ECG signal from pin 1 of U3033A goes to the Display Amplifier, which consists of U3071C and U3071B. U3071C is an inverting operational amplifier with R3158, R5310, and R3160 making up the gain-determining divider. The SIZE control R5310 varies the gain approximately from ×1/3 to ×3 with ×1 gain at SIZE control mechanical center. Amplitude at the output of U3071C is 0.5 V/cm of ECG display.

U3071B is an operational amplifier with a gain of 0.5 as set by R3156 and R3157. The dc level at the output is set by supplying an offset current to the summing node (U3071B-6). The ouput goes to a dc level that will supply the offset current through R3157 and hold the summing node at 0 V. When P/P and Resp Off (P3000-22) is HI, CR3151 is is reverse biased and the divider action of R3151, CR3152, and R3152 provides no offset current. The dc level at the output will be about 0 V.

TRACE RECOVERY AND LEAD FAULT

The trace recovery circuit speeds up the return of an off-screen signal by rapidly charging C3140 in the Ac-Coupled amplifier. C3140 responds to slow change in the ECG input dc offset by charging or discharging through R3140 and R3141. When the level at U3071B-7 exceeds ±1 V (corresponding to ±4 screen divisions), Q3044 is turned on. While Q3044 conducts, R3170 shunts R3140 and R3141 providing a rapid charge path for C3140. Also, during trace recovery or lead fault, the anode of CR3184 is pulled positive to disable the QRS detector.

U3071D is a summing node. When the ECG signal is on on screen (−1 V <ECG wave <+1 V) the sum of the currents supplied to the summing node through R3161 and R3165 is less than that supplied through R3174 (the current through R3172 supplies the difference). This sets U3071D-13 slightly positive causing U3071D-14 to be LO. As a result, the gate of Q3044 is at about −6 V which turns off Q3044.

Assume ECG wave starts going positive. In order to hold U3071A-2 at 0 V, the anode of CR3165 must go negative. When ECG wave reaches about +1 V, the anode of CR3165 is at −1V. The resulting sum of the currents supplied through R3161, R3165, and R3174 is 0 μA. Therefore no current is supplied through R3172 and the gate of Q3044 will be 0 V.

Assume ECG wave goes negative. CR3165 turns off and U3071A-1 goes slightly positive to hold U3071A-2 at 0 V through CR3167. When ECG wave reaches −1 V, the sum of the currents supplied through R3161 and R3174 is 0 μA (no current flows through R3165). Again no current is supplied through R3172 and the gate of Q3044 will be at 0 V.

C3175 delays Q3044 turn-on so that short-duration overdrive signals (such as pacer signals) will not affect Q3044 and the lead-fault circuits. C3175 also delays Q3044 turn-off to allow the recovery action to return the trace to its quiescent level. If turn-off were not delayed, the recovery circuit would rapidly bring the trace to the top or bottom of the screen, then it would slowly drift to its quiescent level.

When the ECG channel is off, a positive signal through CR3179 keeps the LEAD FAULT LED turned off by holding U3071D-13 positive.

CHANNEL OFF SENSE

This circuit consists of Q3095 and Q3096 which provides a logic signal to indicate whether the ECG channel is on or off.

When the ECG channel is off, very little current flows into T3100-2 and the voltage at the base of Q3096 is positive. This produces a 7-volt HI signal at the collector of Q3095. This HI (off) signal keeps the LEAD FAULT LED off and also goes to the Pressure/Pulse, Respiration and Main boards to establish single or dual-trace conditions (when the pressure/pulse and/or respiration channel is on). The HI at the collector of Q3096 also, through CR3183, disables the QRS Detector.

5 V_1 AND −5 V_1 SUPPLIES

These supplies provide power to the Isolated Power Supply and Input Offset circuitry. The +5 V_1 current is supplied from the 7 V supply through Q3098; the −5 V_1 current is supplied from the −7 V supply through Q3099. The regulated +5 V from the power supply provides the reference voltage, non-inverted through amplifier U3089A/Q3098 for 5 V_1, and inverted through amplifier U3089B/Q3099 for −5 V_1.

① QRS DETECTOR CIRCUIT OPERATION

The QRS Detector (Fig. 3-2) evaluates the content of the incoming ECG signal to determine when the QRS portion of the waveform occurs. The QRS segment has at least one slope which has a greater rate of voltage change for a longer period of time than other segments of the ECG waveform. When a QRS segment is detected, an ECG trigger pulse is generated that triggers the sweep and heart-rate beat tone, and supplies rate information to the rate-limit alarm circuits.

The ECG signal passes through the Variable-Gain Amplifier, the Differentiator, and a full-wave rectifier (Absolute-Value-Detector). The resulting positive signal contains one or more large, relatively wide, essentially sinusoidal pulses for each QRS segment at the input. Feed back through the Automatic-Gain Control circuit maintains pulse amplitude at about 3-4 volts at TP3012.

Those portions of the pulses over 1 volt pass through the QRS Level Detector to the QRS Timer. The first pulse greater than 5 ms that enters the QRS Timer circuit produces the ECG Trigger. Any other input pulses (i.e., pulses caused by T-waves) which occur in less than 150 ms after the first pulse, are ignored.

The Pacer Detector circuit prevents pacer signals from producing a QRS trigger signal by shutting off the ECG signal in the QRS Level Detector circuit during the pacer pulse. Lead Fault and ECG Off signals also prevent ECG triggers.

AUTOMATIC GAIN CONTROL (AGC)

The automatic cain control consists of a Variable Gain Amplifier and a Gain Controller.

Variable Gain Amplifier.

U3012C is a non-inverting operational amplifier. Variable-gain feedback to U3012C is provided through the operational transconductance amplifier U3036. The gain of the operational transconductance amplifier circuit varies in direct proportion to the current into pin 5 (from 3 to 300 μA) and the value of R3102. A current of 300 μA into pin 5 sets the gain of U3036 to 100, and the overall gain of the Variable-Gain Amplifier to 1(note the 100 to 1 divider between U3012C-8 and U3036-3). A current of 3 μA into pin 5 sets the gain of U3036 to 1 and the overall gain to 100.

The RC combination of R3102/C3102/C3103 provides a low-frequency rolloff of about 1 Hz.

Gain Controller.

The Gain Controller circuit holds the pulse amplitude at TP3012 at about 3 volts.

In the quiescent state, R3066 tries to pull the emitter of Q3040 to +3.7 V. However, CR3067 clamps the emitter of Q3040 at 0.7 V more positive than the voltage on TP3012.

When a pulse on TP3012 exceeds +3 V, CR3067 becomes reverse biased and Q3040 turns on allowing C3118 to charge through R3066. The voltage on C3118 sets the bias on Q3042 and determines the dc current supplied to pin 5 of U3036 through common base amplifier Q3052 (see Variable Gain Amplifier). Increasing the charge on C3118 increases the current supplied to U3036-5 and reduces the gain of the Variable-Gain Amplifier.

If a QRS signal is not present for several seconds, pin 3 of U3020 remains LO and cuts off Q3061 long enough for C3089 to charge and turn on CR3118. This quickly discharges C3118 through CR3118 and R3089. The decreased charge on C3118 reduces the current through Q3042 and Q3052 and increases the gain of the Variable Gain Amplifier to maximum. When the QRS signal returns, the resulting pulses at TP3012 may exceed 8.8 V causing VR3067 to conduct. This rapidly charge C3118 through R3067 to rapidly reduce the gain to normal.

When the ECG signal at TP3002 exceeds ±7 volts, pin 7 of U3012B goes HI and supplies current to U3036-3 through CR3110, R3110, and common base amplifer Q3052. This decreases the gain of the Variable Gain Amplifier. The increased current in U3036-5 also provides greater current output from U3033 to rapidly charge C3102-C3103 to accommodate any dc level changes at TP3004.

DIFFERENTIATOR AND ABSOLUTE VALUE DETECTOR

Signals from the Variable Gain Amplifier at TP3002 are differentiated and inverted through U3012D. The differentiated signal is then full-wave rectified through CR3062 for the rising portion, and through U3012A (X1 inverting amplifier) and CR3061 for the falling portion. This full-wave rectifier action produces a positive-going pulse at TP 3012 for each pulse transition at TP3002. This results in two positive-going pulses at TP3012 for each pulse at TP3002 regardless of the polarity of the pulse at TP3002.

QRS TIMER

In the quiescent state, R3095 tries to pull the emitter of Q3021 to +1.7 V. However CR3069 clamps it at 0.7 volts above the voltage on TP3012. While the voltage on TP3012 is less than +1 V, Q3021 is off and Q3000 is saturated.

When the voltage on TP3012 exceeds +1 V, CR3069 becomes reverse biased and Q3021 turns on, turning off Q3000. When Q3000 is turned off, C3082 starts charging toward −7 volts. After about 5 milliseconds (depending on the action of the QRS Timer Modulator), pin 2 of U3020 reaches the lower threshold point of U3020 (about −2.3 V), causing pin 3 to go HI to produce the ECG Trigger. When U3020 switches, pin 7 is released and C3084 starts charging towards 7 volts. When pin 6 of U3020 reaches the upper threshold point (about +2.3 V), pin 3 goes LO. The ECG trigger pulse at TP3040 has a duration of about 150 milliseconds.

QRS TIMER MODULATOR

Q3001 provides noise immunity for the ECG trigger circuitry. If considerable 60 Hz or other noise is present, C3082 charge time will be lengthened to a maximum of 8 milliseconds to prevent U3020 from triggering on the noise. If the noise level is low, C3082 will charge at the normal rate (about 5 milliseconds).

Excessive noise voltage at TP3012 charges C3071 through R3071. This turns Q3001 on, which takes charge current from C3082. As noise increases, current in Q3001 increases, lengthening the charge time of C3082. CR3071 limits the voltage on C3071 and this sets the maximum QRS timer interval.

QRS DETECTOR DISABLE

When the QRS signal exceeds ±7 volts and pin 7 of U3012B goes HI, C3116 charges, CR3116 turns on, and CR3132 turns off. This allows the 7 volts through R3132 to turn on Q3083, and pulls the cathodes of CR3066 and CR3078 below 1 V, thus disabling the QRS Detector. A HI signal through CR3183 or CR3184, due to a lead fault or the ECG channel being off, also causes Q3083 to turn on and disable the QRS Detector. A HI pulse from the Pacer Detector momentarily turns on Q3083 to disable the QRS Detector during a pacer signal.

PACER DETECTOR

This circuit keeps pacer signals from entering the Gain Controller and QRS Timer circuits. U3075A is a differentiator with limited upper bandwidth. A pacer pulse at the input to C3120 produces an output at pin 1 of U3075A. When the pulse at pin 1 exceeds or ±5 volts, a negative output at the collector of Absolute Value Detector (Q3085) triggers Q3074 into conduction. This action discharges C3130 in the positive direction, which causes Q3083 to saturate and pull the cathodes of CR3066 and CR3068 below 1 volt. This clamps the Q3040 and Q3021 emitters below 1 volt to lock out signals to the Gain Controller and QRS Timer circuits for the duration of the Pacer Detector output pulse (about 50 milliseconds).

The Absolute Value Detector (Q3085) provides a negative pulse at its collector for positive or negative pulses at its base. If U3075A-1 goes to +12 V, Q3085 is turned off and its collector is pulled to −12 V through R3127. If U3075A-1 goes to −12 V, the base collector junction of Q3085 is forward biased pulling its collector to about −11.3 V.

RESPIRATION BOARD

RESPIRATION BOARD CIRCUIT FUNCTIONS

The Respiration circuit (Figs. 3-3 and 3-4) accomplishes the following:

1. Provides a 50 kHz signal to ECG patient cable leads LA and RA to measure patient chest impedance. The circuit has the same isolation and protection characteristics as the ECG input circuit.

2. Amplifies the detected respiration signal (change in chest impedance).

3. Indicates when a fault exists in the input cables, wires, electrodes, etc.

4. Provides an amplified respiration display signal (amplitude variable with RESPIRATION SIZE control). Display baseline is positioned approximately at screen center, 2 centimeters above, or 2 centimeters below, depending upon status of other channels. See Table 3-1.

5. Provides a logic signal to the Conditioner board to indicate whether respiration channel is off or on. This signal is used to blank the digital readout of respiration rate when the respiration channel is turned off.

6. Provides a logic signal to the Pressure/Pulse board to allow display of the respiration channel. This logic signal also sets the baseline of the pulse display.

7. Provides an inspiration trigger to the Conditioner board for digital display of respiration rate and for analysis of respiratory effort rate alarm conditions.

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RESPIRATION AMPLIFIER CIRCUIT OPERATION

Respiration signal is produced from the change in patient chest impedance that is measured across the LA and RA leads of the ECG patient cable (see Fig. 3-3).

A 50 kHz signal is sent to the patient through T3200, T3000 on the ECG board, and patient cable leads. The chest impedance change (about 1 ohm) is reflected back into T3200 and detected by the Synchronous Detector to produce a respiration signal at TP3232.

The respiration signal is amplified to produce the respiration wave used for the crt display. The respiration signal is also processed by the Inspiration Detector to produce the respiration trigger.

The CVA Detector determines when a chest impedance change is produced by cardio-vascular artifact and disables the inspiration detector.

Logic signals indicating the status of the ECG and Pressure/Pulse channels select the appropriate respiration baseline position through the Respiration Trace Positioning Multiplexer.

50 KHZ DRIVER

A 50 kHz square-wave signal from the Master Oscillator drives T3200 and Synchronous Detector U3235. The ±7 V 50 kHz square-wave signal at pin 30 of P3200 is clipped to ±5 V by CR3200 and CR3201. The signal at TP3207 is inverted with respect to the signal at P3200-30. A ±5 V squarewave wave appears at TP3207. The 50 kHz signal is shut off when Q3276 is turned on by the Respiration OFF switch S5320. When Q3276 is turned on the junction of R3201/C3203/C3205 is clamped to -5 V.

SYNCHRONOUS DETECTOR

The 10 V peak-to-peak square wave at TP3207 appears across R3208 causing a 2 mA peak-to-peak signal to appear in the primaries of T3200 and T3000.

C3032 and L3032 (see ECG schematic) make up a series resonant trap at 50 kHz, effectively causing T3000 secondary windings to be in series. T3000 turns ratio between primary and secondary is 10:1. Thus a 200 μA, peak-to-peak (70 μA rms), 50 kHz signal is present in the patient between leads LA and RA.

Static chest impedance can vary from 0 to 1500 ohms. Since there is a 1 kΩ resistor in each of the patient cable leads, the impedance seen in the secondary of T3000 will be between 2 kΩ and 3.5 kΩ. This total impedance is reflected through T3000 secondary to the T3200 secondary at pins 1 and 3. This results in a 400 mV to 700 mV (550 mV mean), 50-kHz signal at pin 3 of Synchronous Detector U3235.

When the static chest impedance is at the mean value of 750 Ω, the 50-kHz signal at pin 3 of U3235 is about 550 mV. The Null adjustment, R3206, is set so that about the same amplitude signal appears at pin 11 of U3235. This causes the output at TP3232 to be at 0 V dc. With static chest impedances other than 750 Ω, the dc level at TP3232 will be shifted plus or minus accordingly.

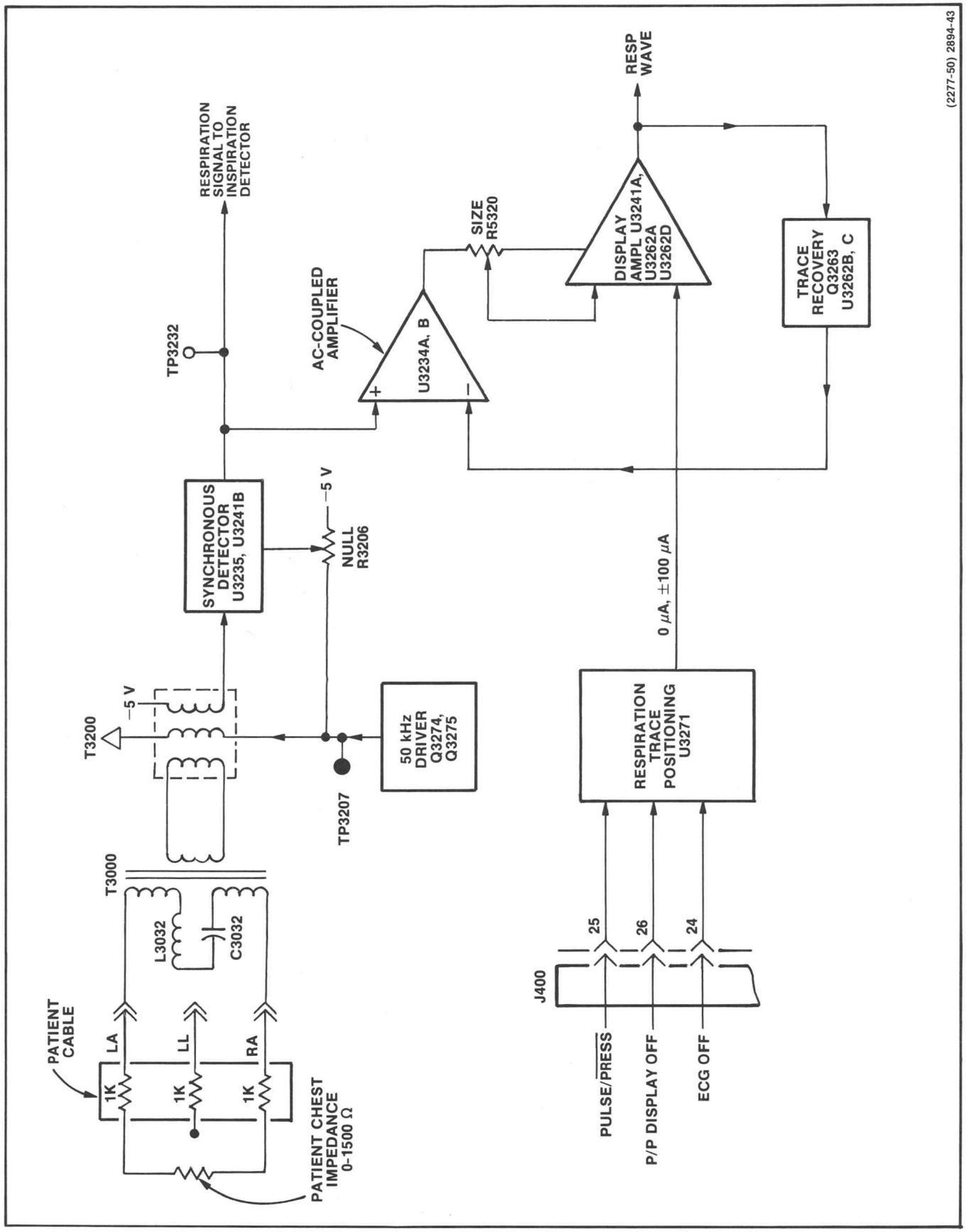

Fig. 3-3. Respiration amplifier block diagram.

During inspiration (expansion of chest cavity), the static chest impedance changes about 1 Ω. This impedance change is reflected back to T3200 to produce a 200 μV change in the amplitude of the 50-kHz signal at pin 3 of U3235. The 200 μV change at pin 3 becomes the respiration signal at TP3232.

The Synchronous Detector compares a 50 kHz reference current (in the transistor at pin 11 fo U3235) with the 50 kHz signal current (in the transistor at pin3 of U3235). These two currents are switched between R3218 and R3219 dependent on the clipped 50 kHz signal at pins 6 and 13 of U3235.

When the signal at pin 6 and 13 is positive, the transistors at pin 6 and 13 are on, causing the reference current to flow in R3218 and the signal current to flow in R3219. When the signal at pins 6 and 13 is negative, the transistors at pins 2 and 9 are on, causing the reference current to flow in R3219 and the signal current to flow in R3218. The difference between the reference current and the signal current determines the charge on C3224. This charge produces the signal voltage and is amplified by U3241B. A reduction in chest impedance causes a reduction in the 50 kHz signal level a U3235-3 which causes U3241B-5 to move in a negative direction with respect to U3241B-6.

AC-COUPLED AMPLIFIER

U3234 and associated circuitry make up a special form of non-inverting amplifier with upper and lower bandwidth limits similar to that in the ECG channel.

Short duration overdrive signals will not shift the display baseline significantly because ac-coupling capacitor C3310 is in the feedback circuit. C3310 normally changes through R3353. During trace recovery, C3310 changes through R3354.

The amplifier gain is determined by R3313, R3309, R3310, R3205 and R3315. High-frequency bandwidth (4 Hz) is determined by R3209, R3310, and C3315. Low-frequency bandwidth (0.1 Hz) is determined by C3310 and R3353.

DISPLAY AMPLIFIERS

The 250 mV/Ω respiration signal from pin 7 of U3234B goes to inverting operational amplifier U3262D. The gain of this amplifier is determined by R3380, R3382, and R5320. The gain is variable with the SIZE control (R5320) from ×1/3 to ×3. Gain of ×1 is at R5320 mechanical center, as marked by the dot on the front panel.

U3241A is a ×2 inverting operational amplifier which provides the respiration signal to the RESPIRATION OUTPUT jack and to the optional recorder.

U3262A is an inverting operational amplifier with a gain of 1. Its output provides the respiration wave that goes to the vertical amplifier for the crt screen display. The Respiration Trace Positioning circuit sets the dc level of the respiration signal according to the status of the pressure/pulse and ECG channels by adding a dc offset current to the amplifier summing node (U3262A-2).

TRACE RECOVERY AND LEAD FAULT

The trace recovery circuit speeds up the return of an off-screen signal by rapidly charging C3310 in the Ac-Coupled amplifier. C3310 responds to slow change in the Respiratory Effort input dc offset by charging or discharging through R3353 . When the level at U3262A-1 exceeds ±1 V (corresponding to ±4 screen divisions), Q3263 is turned on. While Q3263 conducts, R3354 shunts R3353 providing a rapid charge path for C3310. Also, during lead fault, the anode of CR3361 is pulled positive to disable the Inspiration detector.

U3262B-6 is a summing node. When the respiratory effort signal is on on screen (−1 V < Resp wave < +1 V) the sum of the currents supplied to the summing node through R3373 and R3372 is less than that supplied through R3259 (the current through R3357 supplies the difference). This sets U3071D-13 slightly positive causing U3071D-14 to be LO. As a result, the gate of Q3263 is at about −6 V which turns off Q3263.

Assume Resp wave starts going positive. In order to hold U3262C-9 at 0 V, the anode of CR3372 must go negative. When Resp wave reaches about +1 V, the anode of CR3372 is at −1 V. The resulting sum of the currents supplied through R3373, R3372, and R3252 is 0 μA. Therefore no current is supplied through R3357 and the gate of Q3263 will be 0 V.

Assume Resp wave goes negative. CR3372 turns off and U3262C-8 goes slightly positive to hold U3262C-9 at 0 V through CR3378. When ECG wave reaches −1 V, the sum of the currents supplied through R3373 and R3359 is 0 μA (no current flows through R3372). Again no current is supplied through R3357 and the gate of Q3263 will be at 0 V.

C3357 delays Q3263 turn-on so that short-duration overdrive signals will not affect Q3263 and the lead-fault circuits. C3357 also delays Q3263 turn-off to allow the recovery action to return the trace to its quiescent level. If turn-off were not delayed, the recovery circuit would rapidly bring the trace to the top or bottom of the screen, then it would slowly drift to its quiescent level.

When the Respiratory Effort channel is off, a positive signal through CR3363 keeps the LEAD FAULT LED turned off by holding U3262B-6 positive.

RESPIRATION TRACE POSITIONING MULTIPLEXER

The output (pin 3) of U3271 adds positioning current to the input of U3262A at +100 μA, or 0 μA depending on the status of pressure/pulse and ECG channels. See Table 3-1 for trace positioning logic.

TABLE 3-1
Trace Positioning Logic

Channels Displayed In Addition To Resp	U3271 Address				Trace Pos		
	P/P Display Off P3200-26	Pulse/Press P3200-25	ECG Off P3200-24	Dec. ADRS	-2 CM	CENTER	+2CM
PRESSURE AND ECG	0	0	0	0	X		
PRESSURE	0	0	1	1			X
PULSE AND ECG	0	1	0	2		X	
PULSE	0	1	1	3			X
ECG	1	0	0	4	X		
NONE (RESP ONLY)	1	0	1	5		X	
ECG	1	1	0	6	X		
NONE (RESP ONLY)	1	1	1	7		X	

INSPIRATION DETECTOR CIRCUIT OPERATION

The Inspiration Detector circuit (Fig. 3-4) evaluates the content of the incoming respiration signal at TP3232 to determine when inspiration (chest expansion) occurs. The Inspiration Detector recognizes only positive-going slopes lasting at least 100 milliseconds.

When an inspiration signal has been detected, a respiration trigger pulse is generated that supplies respiration rate information to the rate and alarm circuits.

The respiration signal passes through the variable-Gain Amplifier, the Differentiator and the Clipper. The resulting signal at TP3222 is a positive-going pulse representing only the rising portion of the respiration signal. Feedback through the Automatic-Gain Control circuit maintains pulse amplitude at about 3 to 4 volts (at TP3222).

When the pulse at TP3222 exceeds 1 volt the Inspiration Timer begins timing. Only a pulse greater than about 100 milliseconds duration produces a respiration trigger. Pulses of shorter duration are ignored.

The Inspiration Detector is disabled when a lead fault occurs, when the RESPIRATION SIZE control is turned fully counterclockwise to the OFF position, or when a CVA condition has been detected.

AUTOMATIC GAIN CONTROL (AGC)

The Automatic Gain Control consists of a Variable Gain Amplifier and a Gain Controller.

Variable-Gain Amplifier

U3224B is a non-inverting operational amplifier. Variable-gain feedback to U3224B-6 is provided through the operational transconductance amplifier U3226. The gain of U3226 varies in direct proportion to the current at pin 5. The Automatic-Gain Control circuit varies the current at pin 5 of U3226 from 5 to 500 μA. A current of 500 μA into pin 5 sets the gain of U3226 to 167, and the over-all gain of the Variable-Gain Amplifier to 0.6. A current of 3 μA into pin 5 sets the gain of U3226 to 1.67, and the over-all gain to 60. Note the 100 to 1 divider R3323-R3324.

The components R3321, C3321, C3322 provide low-frequency rolloff of about 0.1 Hz.

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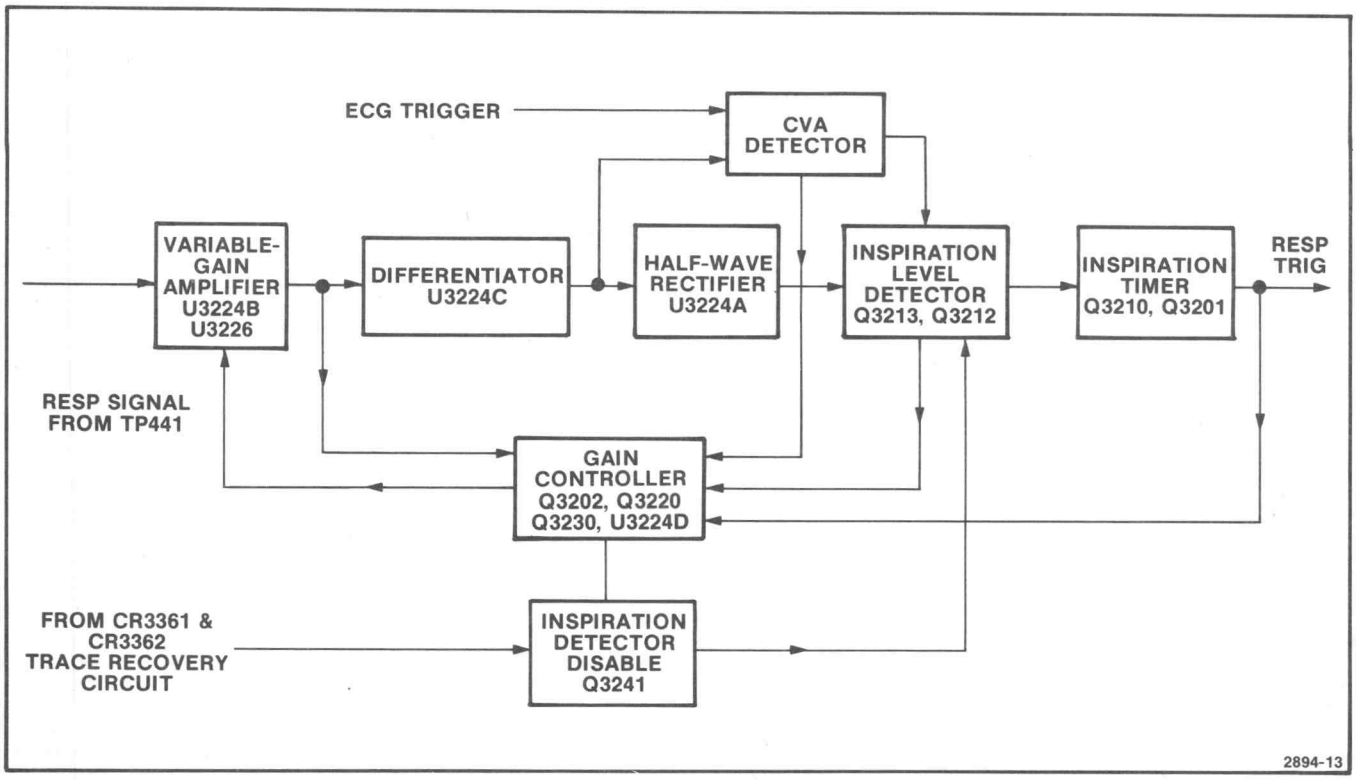

Fig. 3-4. Inspiration detector block diagram.

Gain Controller

In the quiescent state, R3263 tries to pull the emitter of Q3213 to +3.7 V. However, CR3261 holds the emitter of Q3213 at 0.7 B more positive than the voltage on TP3222.

When a pulse on TP3222 exceeds +3 V, CR3261 becomes reverse biased allowing Q3213 to turn on. C3343 can now charge through Q3213 and R3263. The voltage on C3343 sets the bias on Q3230 which controls the current supplied to U3226 through common-base amplifier Q3220 (see Variable Gain Amplifier). Increasing the charge on Q3343 increases the current supplied to U3226-5 and reduces the gain of the Variable Gain Amplifier.

If a respiration signal is not present for several seconds, pin 3 of U3211 remains LO and cuts off Q3202 long enough for C3287 to charge and turn on CR3343. C3343 now rapidly discharges through CR3343 and R3287. This quickly reduces the current in Q3230 and Q3220, and increases the gain of the Variable-Gain Amplifier to maximum. When the respiration signal returns, VR3262 conducts through R3262 to rapidly charge C3343 and reduce the gain to normal.

When the respiration signal at TP3225 exceeds + or −7 volts, pin 8 of U3224D goes HI, turning on Q3220 harder. The increased current to U3226-5 provides maximum current to charge C3221 and C3222.

DIFFERENTIATOR AND CLIPPER

The respiration signal from the Variable-Gain Amplifier at TP3225 is differentiated and inverted through U3224C. The differentiated signal is then again inverted through U3224A and half-wave rectified through CR3260. The resultant signal at TP3222 is one positive pulse for each rising portion of the respiration signal.

INSPIRATION TIMER

In the Quiescent state, R3271 tries to pull the emitter of Q3212 to +1.7 V. However, CR3266 clamps the emitter of Q3212 at 0.7 V more positive than the voltage on TP3222. While the voltage on TP3222 is less than 1 V, Q3212 is off and Q3210 is saturated.

When the voltage on TP3222 exceeds 1 V, CR3266 becomes reverse biased and Q3212 turns on which turns off Q3210. When Q3210 is turned off, C3278 starts charging towards −7 volts. After about 100 millisecond, pin 2 of U3271 reaches the lowest threshold point of U3211 (about −2.3 V), causing pin 3 to go HI to produce the leading edge of the respiration trigger. At the time Q3212 turns on, Q3201 turns on, which keeps C3282 discharged. When the inspiration pulse at TP3222 drops below +1 volt, Q3201 is turned off, allowing C3282 to charge toward +7 volts. Holding C3282 discharged keeps the INSPIRATION light on during an entire sensed inspiration regardless of its duration. After inspiration has ceased, Q3201 turns off and C3282 is allowed to charge. When pin 6 of U3211 reaches the upper

threshold point (+2.3 V), pin 3 goes LO. The respiration trigger pulse at TP3210 has a duration of about 150 milliseconds longer than the inspiration pulse at TP3222.

INSPIRATION DETECTOR DISABLE

When the respiration signal exceeds + or −7 volts and pin 8 of U3224D goes HI, C3345 charges, CR3345 turns on and CR3348 turns off. This allows the +7 volts through R3348 to turn on Q3341 and and hold the cathodes of CR3267 and CR3268 below +1 volt disabling the Inspiration Detector. A HI signal from CR3361 or CR3362, due to a lead fault or to the respiration channel being turned off (S5320 closed), also causes Q3241 to turn on and disable the Inspiration Detector. When a CVA condition is sensed, Q3267 turns on which holds the anode of CR3267 below 1 V and disables the inspiration timer circuit, but allows the AGC to maintain its signal level.

CVA DETECTOR OPERATION

When no inspirations are detected, the gain of the inspiration detector automatically increases. This allows the inspiration detector to sense the change in chest impedance due to blood flow through the lungs. This impedance change is defined as a cardio-vascular artifact (CVA). To properly sense abnormal respiratory effort, the CVA detector causes sensed CVA occurences to be ignored. This is done by checking for coincidence between the ECG signal and the respiration signal.

Figure 3-5 shows the relative timing of signals present in the circuit.

U3227B is a one shot that provides an enable window. The enable window is 220 ms nominal and is intiated by the ECG trigger. The enable window is delayed slightly through R3240 and C3240.

A positive going pulse at U3224-8 corresponds to a reduction in chest impedance. If this pulse exceeds about +150 mV, U3228B-7 steps HI. If this transition occurs after reset has been removed from U3257B-6, a HI is clocked to U3257B-5. This sets U3278C-8 HI. At the end of the enable window, U3278C-9 is set HI causing U3278C-10 to go LO. After a time determined by R3240 and C3240, U3257A is reset. This causes U3278C-10 to go HI clocking U3257B. When the count in U3257B reaches 4, U3257B-2 steps HI. This turns on Q3267 and holds Q3212 off. This prevents generation of an inspiration trigger (see Inspiration Detector Disable).

U3257B-2 also holds the cathode of CR3343 at about 0 V through CR3284 and voltage divider R3284-R3287. This prevents CR3343 from becoming forward biased and rapidly increasing the gain of the Inspiration Detector circuit (see Automatic Gain Control description).

If an ECG trigger occurs and no pulse occurs at TP3229 during the resulting enable window, U3257B is reset at the end of the enable window (see Figure 3-5).

LOW ECG RATE DETECTOR

This circuit sounds the respiratory effort rate alarm and/or respiratory effort arrest alarm (if enabled) when the ECG rate is less than 60 bpm. This circuit detects Bradycardia (low heart rate which often occurs during respiratory effort arrest). During calibration, the simulated ECG rate should be kept above 70 bpm if either the respiratory effort rate alarm or respiratory effort arrest alarm are enabled.

The ECG trigger signal triggers one shot U3227A (period of 500 ms). The output of U3227A is filtered by R3220/C3232. At a duty factor of 50% (ECG rate of 60 bpm) the filter output rises to about 0V. When the filter output goes more positive than 0 volts, U3278D-11 goes LO. This LO resets the CVA detector to prevent latchup if the ECG channel is turned off while in a CVA condition. The LO also passes to the Conditioner board (see diagram 5). This LO resets U3652B causing the respiratory arrest alarm to sound (if enabled). The LO also pulls U3623D-9 LO through CR3630. This sounds the respiratory effort rate alarm (if enabled).

75 BPP

GO ON STEADY

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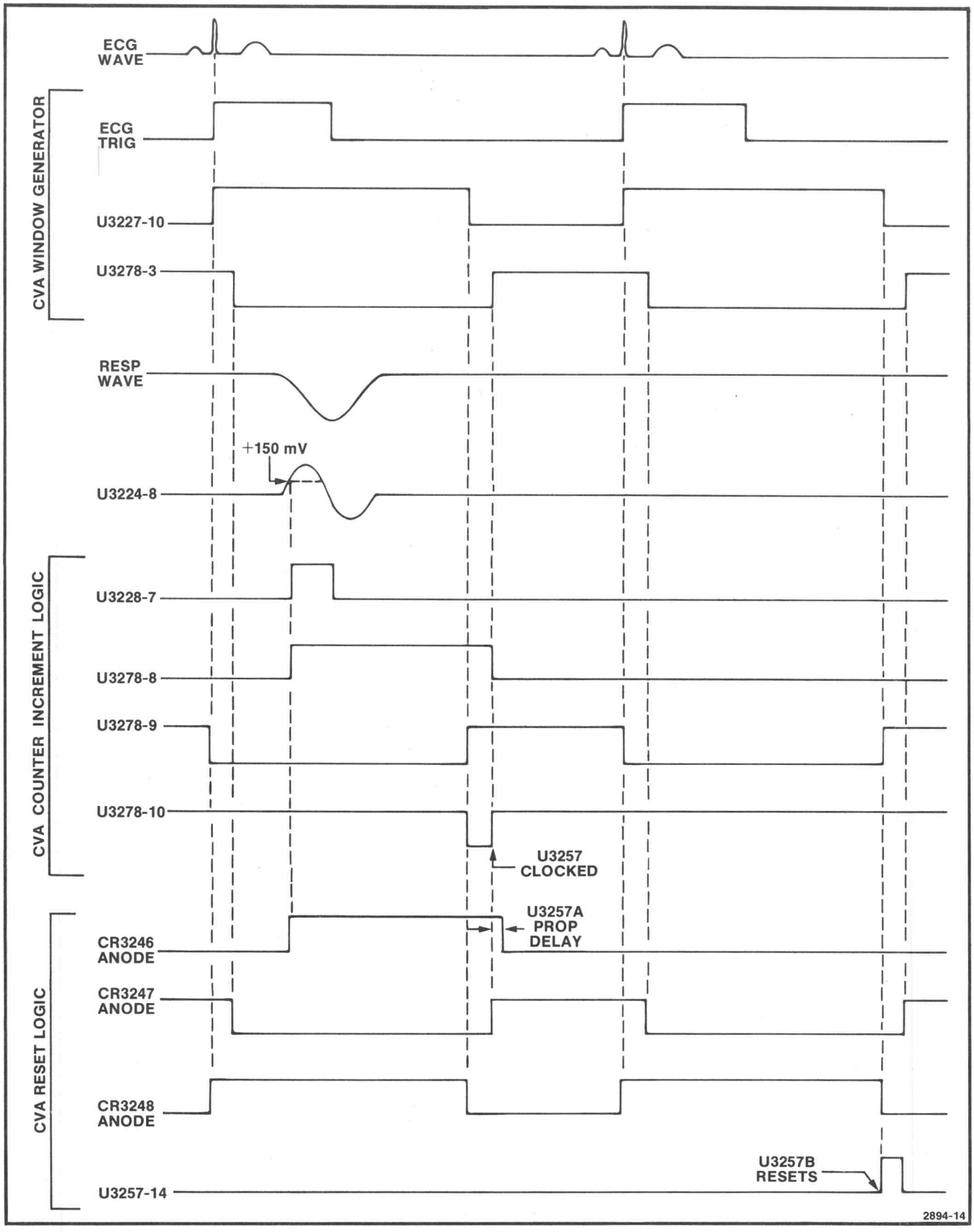

Fig. 3-5. CVA detector timing.

PRESSURE/PULSE BOARD

PRESSURE/PULSE BOARD CIRCUIT FUNCTIONS

The Pressure/pulse board accomplishes the following:

PRESSURE CHANNEL

1. Provides +8V and -8V pulsed exitation to pressure transducer.
2. Reconstructs and amplifies pressure waveform from transducer.
3. Provides zero adjustment to null transducer offset.
4. Provides 100 mm test for pressure transducers with 100 mm test resistor.
5. Provides gain switching for 0-25, 25-75, 0-125 mm CRT display.

PULSE CHANNEL

1. Provides +3.6V exitation to pulse transducer.
2. Amplifies signal from pulse transducer.
3. Provides variable gain.
4. Provides trace recovery for off CRT pulse signals.
5. Moves Pulse CRT trace down 2 cm if ECG and or Resp Traces are on CRT.

CRT TRACE CHOPPING

1. Provides chopping between respiration and pressure/pulse waveforms (ECG chopping is done on the main board).

CLOCK DIVIDER

1. Derives control signals for pressure channel and chopping.
2. Disables PRESSURE CHANNEL if no pressure transducer is connected.
3. Disables PRESSURE CHANNEL if PULSE is selected.

TRIGGER

1. Derives trigger from pressure or pulse for use if ECG is off.

SIGNALS TO REMAINDER OF MONITOR

1. A/V WAVE/PULSE WAVE: To rear panel connector and optional 400 recorder.
2. P/P/RESP WAVE: Chopped waveform to vertical amplifier.
3. A/V WAVE SCALED: To systolic/diastolic/mean converters and pressure zero on conditioner board.
4. PRESSURE/PULSE TRIG: Used to trigger sweep and heart rate converter if ECG is off.
5. SKIP A/V: Blanks pressure readouts if no transducer is connected or pulse is selected.
6. PRESSURE/PULSE & RESP OFF: Moves ECG trace up 2 cm from center of CRT if Pressure/Pulse and or Respiration are on CRT.
7. PRESSURE/PULSE: Used to enable the pulse alarm if PRESSURE/PULSE ALARM button is pressed.
8. PRESSURE/PULSE TRACE OFF: To respiration board for trace positioning.

PULSE AMPLIFIER CIRCUIT OPERATION

The pulse circuit consists of a Pulse-Sensor Excitation Supply and an ac-coupled Pulse Amplifier to amplify the pulse sensor output signal. The pulse sensor consists of a light (incandescent or LED) and a resistive photocell. Pulse signal is produced when the photocell resistance changes with varying light intensity due to peripheral blood volume changes.

The pulse signal is amplified by the Pulse Amplifier. A Trace Recovery circuit is provided to quickly return large off screen signals.

PULSE-SENSOR EXCITATION SUPPLY

This supply is zener referenced to provide a constant output voltage. U3453B is an inverting operational amplifier with a gain less than one. R3412 and R3409 determine the gain reduction needed to reduce the -8.2 V at zener diode VR3413 to +3.6 V at the emitter of Q3443.

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PULSE AMPLIFIER

The Pulse Amplifier is made up of U3462, U3443D, and U3443A. Feedback is provided through R3423 and C3416, causing the low-frequency rolloff to be about 0.2 Hz. High-frequency rolloff is determined by C3418, C3421, and C3434.

The pulse signal is developed across the PULSE SIZE control and passes through inverting operational amplifier U3453A. The maximum total gain of the Pulse Amplifier from input at pin 12 of U3443D to pin 1 of U3453A is about 750. The gain is variable by the PULSE SIZE control to a minimum of about 20.

PULSE TRACE RECOVERY

U3443B, U3443C, and associated circuitry provide for rapid return of off screen pulse signals.

Pin 10 of U3443C is set at -2.5 V and pin 5 of U3443B is set at +2.5 V. When the pulse signal at pin 1 of U3453A exceeds -2.5 ,V pin 8 of U3443C goes HI turning on CR3426 and CR3428. This places R3424 in parallel with R3423, thus increasing the low-frequency rolloff. Similarly, when the pulse signal at pin 1 of U3453A exceeds +2.5 V, pin 7 of U3443B goes LO and turns on CR3427 and CR3429.

PRESSURE AMPLIFIER CIRCUIT OPERATION

The Pressure Amplifier circuit (Fig. 3-6) is chopper stabilized. The pulsed excitation voltage allows the cancelling out of DC offset which is the only voltage present on the PRESSURE AMPLIFIER input stage when excitation voltage is turned off. This technique also improves signal to noise ratio (transducer output is proportional to excitation voltage) because use of higher excitation voltage is possible. Finally, transducer thermal offset drift is reduced because excitation time is small, thus power discipation in the transducer is small.

During previous cycles, coupling capacitor C3481 has been grounded through U3434A. Thus any input amplifier offset, including drift, has established a charge on C3581. At this time, just before TØ U3434A & D are open (see Fig. 3-7).

At TØ, the excitation supply turns on. The Pressure Transducer and input amplifier stabiize. After about 0.5 ms, a voltage representing pressure level has settled at U3423C output. Since C3581 was previously charged to the amplifier offset level, only the signal representing the pressure level is passed on (dc restoration).

The sample and hold switch (U3434D) closes at TØ +0.5 ms and the sample & holding capacitor (C3584) charges to the signal level. At TØ +1 msec sample switch U3434D opens and the excitation supply shuts off. At TØ +2 msec U3434A closes and again grounds C3581 until TØ +7 msec. The cycle then repeats after 8 msec.

PRESSURE-TRANSDUCER EXCITATION SUPPLY

This excitation supply consists basically of a pair of inverting operational amplifiers Q3461/U3451A and Q3451/U3451B. The supply provides a pulsed +8 and -8 volt output to power the pressure transducer bridge.

When the (conditional) Time Zero pulse (from pin 2 of U3454D) causes pin 8 of U3455D to go HI, CR3504 is turned on and pin 6 of U3451B starts HI. Pin 7 starts LO and turns on CR3508, reducing the gain to 1. Since pin 5 of U3451B is at ground, pin 7 is one junction below ground, Q3451 is turned off, CR3506 is turned on, and the emitter of Q3451 is held at zero volts.

When pin 8 of U3455D goes LO, CR3509 is turned off, causing pin 6 of U3451B to start LO. Pin 7 of U3451B starts HI, turning off CR3508 and CR3506 and turning on Q3451. The gain of operational ampifier U3451B is then set by R3508 and R3509/R3513. This sets the emitter of Q3451 at +8 V.

The pulsed +8 volt output at the emitter of Q3451B is the input to inverting operational amplifier Q3461 and U3451A which produces the pulsed -8 volt output of the excitation supply. When the Time Zero pulse at pin 10 of U3445C is HI, diodes CR3525, CR3518, and CR3521 are turned off and the gain of U3451A is one (determined by R3515 and R3518). Thus the emitter of Q3461 is set to -8 volts.

When the Time Zero pulse at pin 10 of U3445C is LO, diodes CR3525, CR3518 and CR3521 are turned on and the emitter of Q3461 is set to zero volts.

PRESSURE INPUT AMPLIFIER

The +8 and -8 volt output from the Pressure Transducer Excitation Supply are applied to the pressure transducer bridge. The output of the transducer bridge are applied differentially to U3423A and U3423D which feed U3423B (instrumentation amplifier circuit with an ac gain of about 115).

Capacitor C3557 adds substantial low-frequency degeneration to the amplifier to keep the quiescent dc level low at the output of U3423B. Since the amplifier is chopper stabilized, flat response to dc is not required.

The outputs of U3423A and U3423D are applied to differential-to-single- ended-out amplifier U3423B. The output of U3423B is applied to inverting operational amplifier U3423C. The Gage Factor adjustment (R3580) varies the gain by changing U3423C feedback resistance.

The ZERO control R5344 provides a + or - offset voltage to the U3423A input to correct for transducer residual imbalance. R5344 is a dual element single shaft control. R5344A (coarse) has about 60 deg of non-functional rotation. The functional portion provides coarse adjustment. R5344B (fine) has continuous rotation and provides fine adjustment.

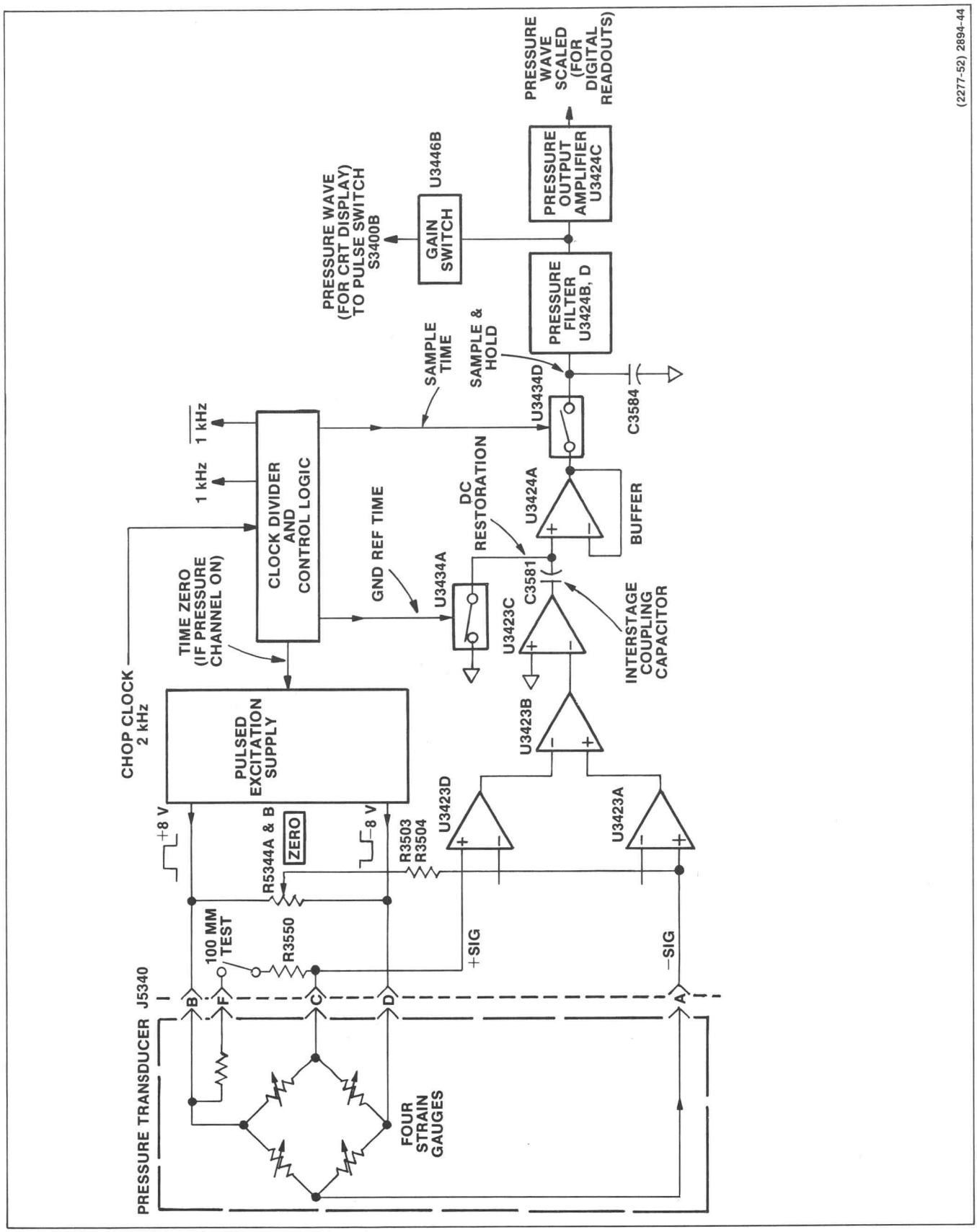


Fig. 3-6. Pressure amplifier block diagram.

The 100 mmHg TEST pushbutton connects the +8 volt side of the excitation supply through calibration resistors, one in the transducer and R3550, to the U3423D input, simulating a 100 mmHg pressure level.

If no transducer is connected to the input or pulse is selected, Q3444 on and diables the pressure channel.

CLOCK DIVIDER AND CONTROL LOGIC

2 kHz from the main board is divided by 2 by U3464A to form 1 kHz and $\overline{1\ kHz}$ (see Fig. 3-8). U3454 sets up sequential logic used to form Time Zero, GND REF Time, and Sample Time. Other logic disables these signals if Pulse is selected or no pressure transducer is installed.

2 kHz from the Main board is inverted by U3445D so U3464A (÷2) will change state on the negative going 2 kHz edge. The D input to U3464A is connected to Q so that with each clock pulse, Q switches to the opposite state. Q provides 1 kHz and $\overline{Q}$ provides $\overline{1\ kHz}$ to the trace chopping logic.

1 kHz from U3464A also drives U3454, an 8 state counter with 8 decoded outputs. Each of the 8 outputs goes high, one at a time, for 1 msec.

TIME ZERO is gated by SKIP A/V at U3445C and fed to the excitation supply. Thus, the excitation supply is disabled if no pressure transducer is connected or pulse is selected.

SAMPLE TIME is formed by gating Time Zero with 1 kHz at U3435B and gating that result with SKIP AV at U3435D. The result is a signal which during normal operation goes high during the second half of Time Zero. If no pressure transducer is installed or PULSE is selected, SAMPLE TIME is forced high.

GND REF Time is formed by setting R-S flip flop U3464B with ÷8 U3454 Q2 and resetting U3464B with ÷8 U3454 Q7. The Q output of U3464B is gated with SKIP AV at U3435C. The result is a signal which goes high for 4 msec (starting 2 msec after Time Zero starts) and also goes high if no pressure transducer is installed or pulse is selected.

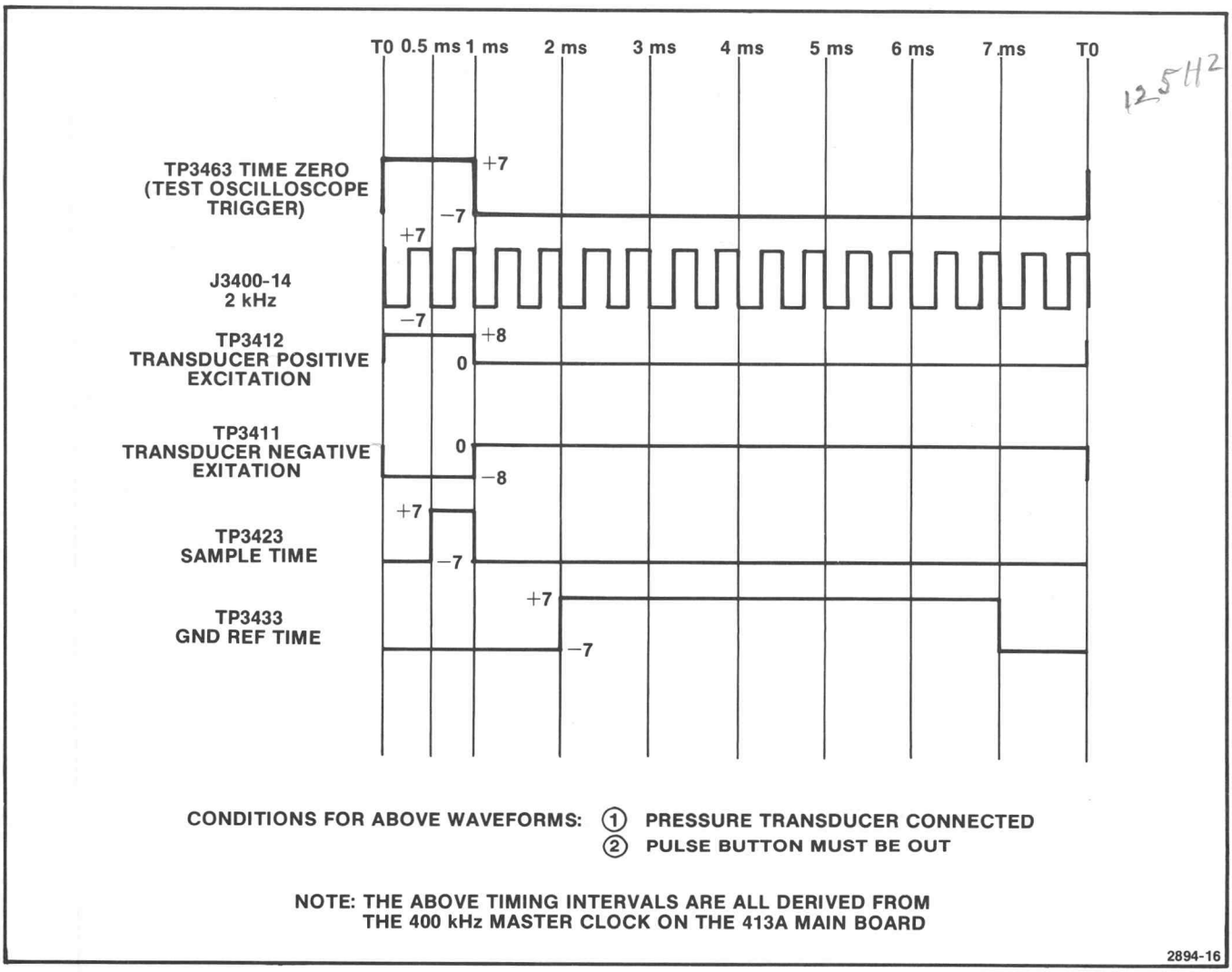


Fig. 3-7. Pressure amplifier timing.

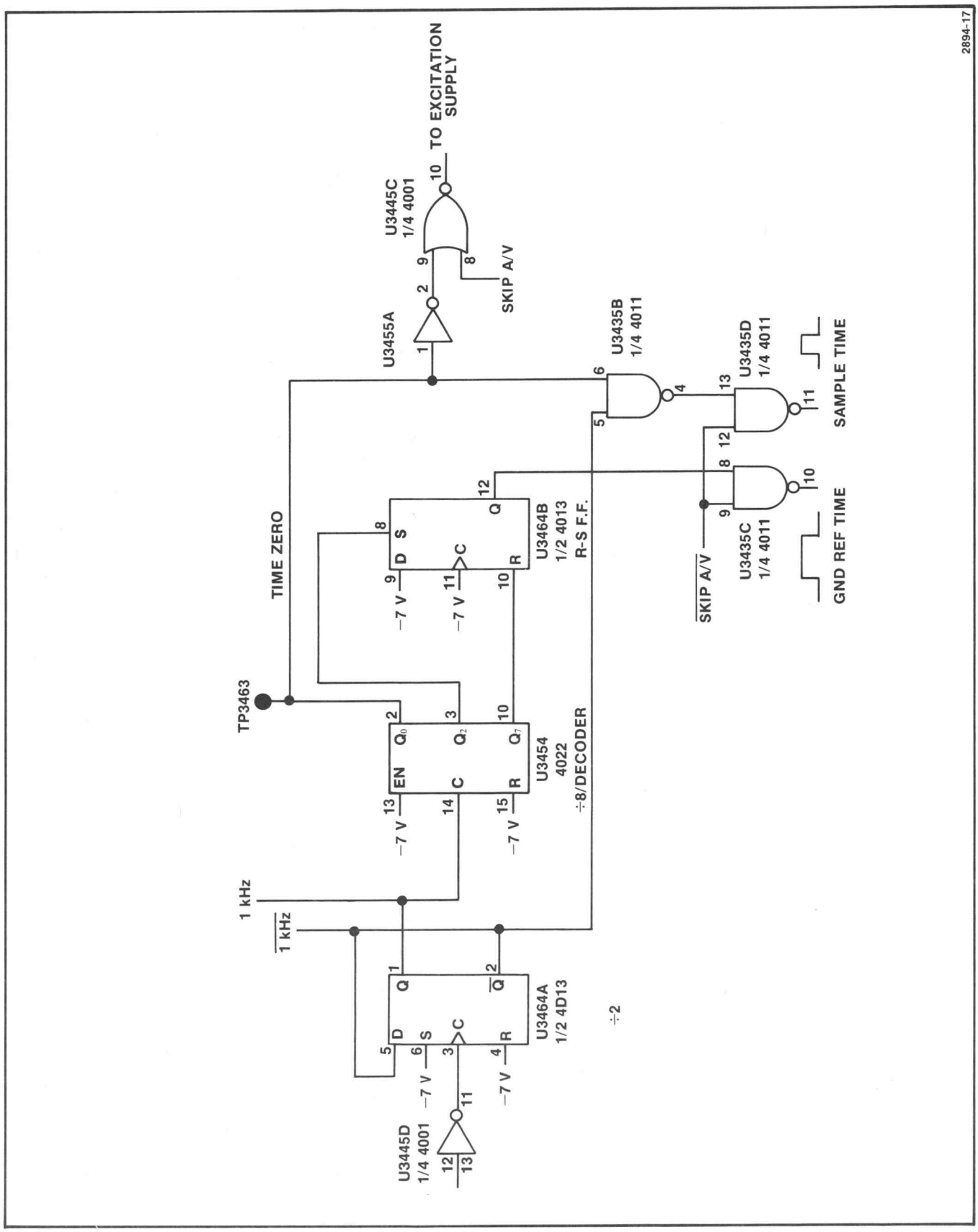


Fig. 3-8. Clock divider and control logic.

PRESSURE FILTER

Components R3585, R3586, C3585, C3586, and U3424D make up a 2-pole low-pass filter. This filter smooths the reconstruction of the pressure signal from the sample and hold circuitry.

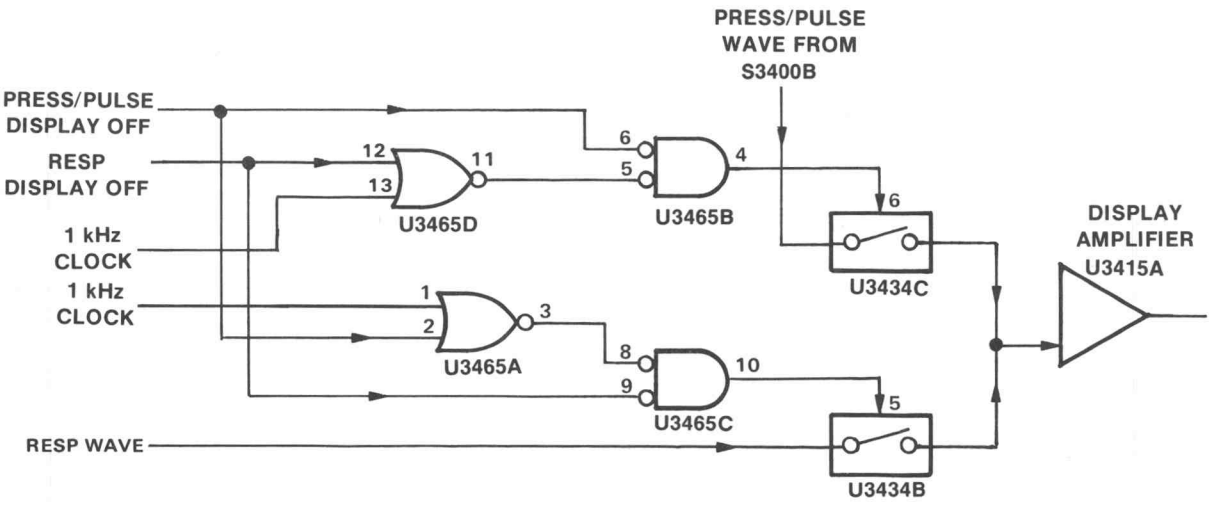
CRT DISPLAY GAIN SWITCHING

The output of the PRESSURE FILTER feeds U3446B which sets gain for the CRT display by switching feedback resistors and offsets the 25 mm-75 mm range by adding 50 μA to the summing node, U3446B pin 6. The output of U3446B goes to the pulse switch.

The output of the PRESSURE FILTER also feeds U3424C which inverts the Pressure waveform so positive pressure is positive voltage and reduces the amplitude by 1/2 so 1 volt = 100 mmHg. This signal is called A/V Wave Scaled and drives the digital readout circuitry.

PRESSURE/PULSE-RESPIRATION TRACE CHOPPING

Switches U3434B and U3434C close to connect the respiration and/or pressure/pulse waves to the Pressure/Pulse/Respiration Display Amplifier. When both channels are displayed simultaneously, U3434B and U3434C are opened and closed alternately by the 1-kHz clock from the Clock Divider. Figure 3-9 shows the switching logic for this circuit.



	BOTH CHANNELS ON	RESP ON ONLY	PRESS/PULSE ON ONLY	BOTH CHANNELS OFF
PRESS/PULSE DISPLAY OFF U3465B, PIN 6 U3465A, PIN 2	LO	HI	LO	HI
RESP DISPLAY OFF U3465D, PIN 12 U3465C, PIN 9	LO	LO	HI	HI
U3465D, PIN 11			LO	LO
U3465A, PIN 3		LO		LO
PRESSURE/PULSE DISPLAY GATE U3434C	OPENED AND CLOSED ALTERNATELY BY 1 kHz CLOCK	OPEN	CLOSED (PIN 6-HI)	OPEN
RESP DISPLAY GATE U3434B		CLOSED (PIN 5-HI)	OPEN	OPEN

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Fig. 3-9. Pressure/pulse-respiration trace-chopping logic.

When both pressure/pulse and respiration channels are off, a HI signal from pin 12 of U3455F is sent to the ECG board to position the ECG display to the center of the screen.

When either or both pressure/pulse or respiration channel is on, this signal is LO and the ECG display is positioned two centimeters above the center of the screen.

When both pressure/pulse and respiration channels are on, pin 5 of U3445B is LO and 2-kHz chop blank pulses are produced at pin 4 OF U3445B.

PRESSURE/PULSE TRIGGER DETECTOR

This circuit converts either the pressure out of the Gain Switching circuit or pulse signal, to a step signal at U3456B output. The negative step at U3456B output is inverted by U3455B. The positive step triggers the horizontal sweep, rate alarm, beat tone, and heat rate digital display when the ECG channel is off. This signal is used by the pulse alarm if pulse is selected.

The trigger circuit produces a positive-going step of approximately -7 to +7 volts at the inverter output, at about 150 millivolts above the most negative excursion of the pressure or pulse signal. See Figure 3-10.

As the input signal goes negative, pin 3 of U3456A is more negative than pin 2. Pin 1 goes negative, CR3474 conducts, and the charge on C3474 goes negative with the input on pin 3.

The input signal reaches its most negative excursion and starts positive. Since pin 2 is held at the most negative excursion of the input signal, and pin 3 starts positive, pin 1 goes positive and turns off CR3474.

Pin 6 of U3456B is approximately 100 millivolts below the input signal due to current in R3472 (set by R3473 to -7 V).

Pin 7 of U3456B is HI (approximately +5 V). The approximately 5 microamperes of R3477 current through R3476 sets pin 5 at about 50 millivolts above the voltage on C3474.

When the input signal rises to about +150 millivolts (100 millivolts plus 50 millivolts) above its most negative excursion, U3456B switches, U3456A pin 1 goes LO, and pin 4 of U3455B goes HI. Since pin 7 of U3456B has now jumped to about -5 volts, pin 5 goes to about 50 millivolts below the voltage on C3474.

As the input signal continues to rise, C3474 charges slowly in the positive direction, as shown in Figure 3-10. The input signal reaches its most positive excursion and starts back down. Nothing further occurs until the level pin 6 of U3456B drops more negative than pin 5 (i.e., when the input signal drops below a level 50 millivolts above the voltage on C3474.

Now, U3456B switches back, pin 7 of U3456B goes HI, and pin 4 of U3455B goes LO. Thus, the trigger signals is a step related to the input signal as shown in Figure 3-10.

The exact trigger point may differ on very large amplitude signals.

PRESSURE/PULSE/RESPIRATION DISPLAY AMPLIFIER

U3415A and U3415B provide the appropriate signal levels for display of the pressure, pulse, or respiration waves.

Pressure/pulse and/or respiration waves are selected by U3434B and/or U3434C.

When respiration wave is selected by U3434B, the gain of U3415A is 1 (as determined by R3484 and R3459). Protection diodes CR3470 and CR3471 hold U3434C input level to within 0.6 volts of ground. Protection diodes CR3460 and CR3461 hold U3434B input level within 0.6 V of ground.

When pressure or pulse is selected by U3434C, the gain is 0.5 (as determined by R3484 and R3470). In the pressure mode, R3465, R3466, and R3468 (Trace Zero adjustment) are connected to the U3415A input to set the pressure-trace zero position. For the 0-25 and 0-125 pressure positions the trace zero is set to the bottom graticule line.

Diodes CR3484, CR3487, and CR3488 limit the output of U3415A to below about +1.8 volts.

U3415B is an inverting operational amplifier with a gain of 1. The output at pin 7 of U3415B drives the Trace Chopping circuit on the Main board.

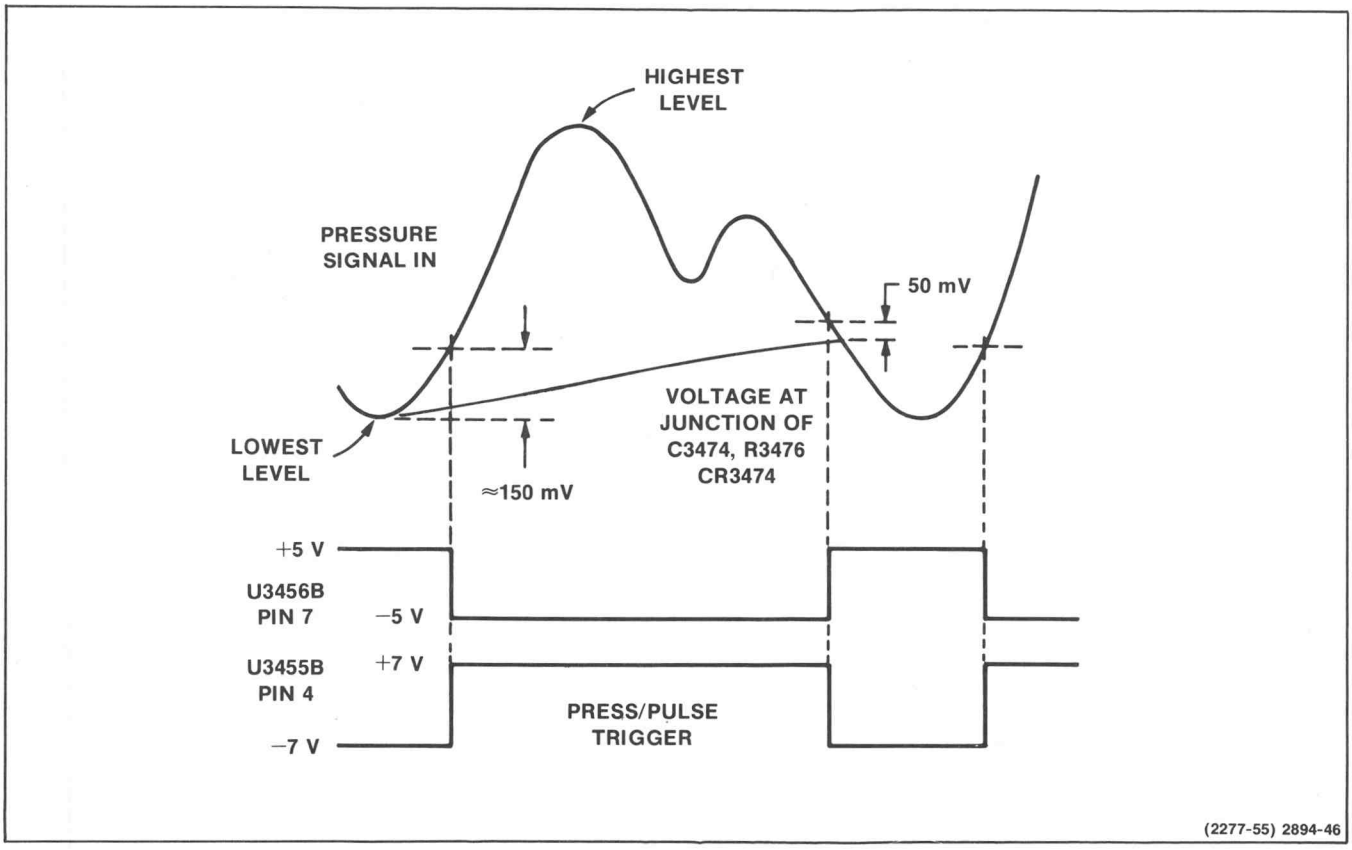


Fig. 3-10. Pressure/pulse trigger points.

CONDITIONER BOARD

CONDITIONER BOARD CIRCUIT FUNCTIONS

The Conditioner board accomplishes the following:

1. Converts the selected trigger (derived from ECG, pressure, or pulse signals) to a dc voltage level related to the average beat rate.

2. Converts the respiratory effort trigger to a dc voltage level related to the average respiratory-effort rate.

3. Converts the signals from the temperature probes to dc signal levels directly related to temperature.

4. Provides a temperature difference signal (Temp A − Temp B) by subtracting the two temperatures algebraically.

5. Samples and holds the peak values of systolic and diastolic pressures. The filtered output provides a dc level (for each pressure) that is directly related to the average systolic or diastolic pressure level measured by the pressure transducer.

6. Filters the pressure signal to produce a voltage representative of the mean value of the pressure signal.

7. Provide a means of selecting the desired functions via a readout selector and readout selector decoder using a binary coding system.

8. Produces both visual and audible alarms, The alarm operates when: 1) heart and/or respiration rate goes above or below the limits set by front-panel controls, 2) average pulsatile pressure level (difference in systolic and diastolic pressures) falls below about 5-10 mmHg, or 3) pulse display falls below 0.3-0.5 cm, or 4) respiratory effort arrest alarm occurs.

9. Provides an alarm latch that can be reset to clear the alarm either from the front panel or from an external reset switch.

RATE AND TEMPERATURE CONVERTER CIRCUIT OPERATION

HEART RATE CONVERTER

Normal Operation

The Heart Rate Converter is basically a one-shot multivibrator (multi) that is fired at every heart-beat. The one-shot multi output controls an analog switch that gates either ground or -12 volts into the four-pole filter. The filter output ranges between 0 volt for no heart beat to +3 volts for a beat rate of 300 per minute, or more.

U3617B is a 200 ms one-shot which is triggered on the negitive-going edge of the selected trigger pulse. When U3617B is triggered U3617B-10 goes HI. This switches U3615B so that C3636 charges toward -6 V through R3633.

When U3617B times out, U3617B-10 steps LO. This switches U3615B so that C3636 discharges through R3634 to ground. The resulting average charge on C3636 is proportional to the selected trigger rate (heart rate). The voltage on C3636 is filtered through U3614B. The gain of U3614B is adjustable to calibrate the output to 10 mV per beat per minute (i.e., 100 bpm = 1.000 V out).

Overrange Operation

If the heart rate exceeds about 300 bpm, the time between beats falls below 200 ms and U3617B will be retriggered before it times out on each beat. U3617B-10 remains HI allowing C3636 to charge toward -6 V until it reaches that voltage (voltage divider action of R3688, R3636, and R3633). This produces a +3 V output from the filter which produces a 300 bpm reading on the digital display even though the actual rate may be higher.

R3631, CR3633, and CR3631 prevent U3615B-3 from dropping below -7 V. This prevents forward biasing protection diodes in U3615B.

Overrange indication is provided by U3616A. If a trigger pulse occurs before U3617B times out, U3617B-10 is still HI allowing U3616A to be triggered through U3619B. This causes U3616A-6 to go HI and cause overrange flashing of the digital display.

RESPIRATORY EFFORT RATE CONVERTER

The Respiration Rate Converter circuit is identical to the Heart Rate Converter circuit, with a couple of exceptions. One-shot multi U3617A has a period of 400 milliseconds instead of 200 milliseconds, and U3614A has a gain of 0.25 instead of 0.5. The differences cause the DVM signal to represent up to a maximum of 150 (breaths/minute) instead of 300 (beats/minute) and the overrange to occur at 150 instead of 300.

TEMPERATURE CONVERTERS

Both A and B temperature converters operate in the same manner. Therefore, only the A converter will be discussed.

The Temperature A Converter circuit converts the probe temperature to a voltage that can be used by the DVM. The temperature probe contains two thermistors and produces, with some external circuitry, a nearly linear voltage vs. temperature curve. Due to the non-linearity of the thermistors in the temperature probe a slight S-curve response is produced in the converter output. The resulting maximum design center error is less than one 413A DVM count (1 mV). The linear range is -5° to +45° C (+23° to +113° F).

R3664 and R3665 are the linearizing resistors. A linear output depends on these resistors and the accuracy of the 1.759 V supply.

U3611A is a buffer amplifier to isolate the probe and linearizing resistors from the following circuitry. Its output is approximately +1.17 V at the calibration point (+25°C/77°F) and decreases by about 10 mV per degree C as the measured temperature increases.

U3611D provides the dc offset and gain required to calibrate the converter output. When °C function is selected, R3680 adjusts the dc offset to a design center value of 710 mV (at U3611D-12). When °F function is selected, R3622 adjusts the dc offset to 970 mV.

When measuring Celsius, U3613C connects the junction of R3682 and R3683 to the inverting input of U3611D to set its gain at -1. When measuring 25°C this would produce an output of -1.17 V. However, R3680 sets the dc voltage on the +input of U3611D so that its output is 0.250 V. When measuring Fahrenheit, U3613C connects the junction R3680 and R3682 to the inverting input of U3611D to set its gain at -1.8. When measuring +77°F this would produce and output of -2.1 V (-1.8 ×+1.17 V). However, R3622 sets the dc voltage on the +input of U3611D so that its output is +0.770 V.

TEMPERATURE PROBE FAULT AND NO-PROBE SENSING

The voltages at P3610-3 (V_A) and P3610-1 (V_B) are monitored to sense probe faults (See diagram 4).

At all measured temperatures above about -10°C, V_B will be less than 0.8 V_A. The divider action of R3668 and R3669 sets U3610B-6 at 0.8 V_A. If T1 opens or the probe ground opens, V_A equals V_B. This sets U3610B-5 more positive than U3610B-6 and its output goes HI causing the output of U3621C to go HI. When U3621C-8 goes HI, the digital display blanks. Since $V_A = V_B = 1.759$ V when no probe is inserted, this circuit also causes no-probe blanking.

@

At all measured temperatures below about 55°C, V_B is greater than 100 mV. U3621C compares V_B to 100 mV. When T1 and/or T2 short, V_B falls below 100 mV causing U3621C-8 to go HI to blank the digital display.

TEMPERATURE DIFFERENCE AMPLIFIER

U3607 is a differential amplifier, providing an accurate output signal equal to temperature A minus temperature B. R3726, R3727, R3729, and R3730 are 0.1% resistors to maintain high common mode rejection ratio of amplifier.

△T Zero adjustment R3732 compensates for U3607 input offset voltage and is adjusted to make the A-B readout value equal to the value calculated from the Temperature A and Temperature B readout values.

TEMPERATURE OVERRANGE

U3612A, U3612B, U3645D, and U3623B form a window detector. Whenever the measured temperature is between -5° and +45°C (+23° and +113°F), The voltage at U3611A-1 will be between +0.94 and +1.5 V and U3623B-4 will be LO. When the temperature falls outside the above range, U3623B-4 goes HI to indicate overrange.

6
PRESSURE CONVERTER CIRCUIT OPERATION

The Systolic/Diastolic Converter is a sampling circuit followed by a two-pole filter.

SYSTOLIC/DIASTOLIC CONVERTER

U3613B and U3615C are CMOS switches that will select between two pressure input circuits.

U3636A is a buffer amplifier to isolate the pressure converter from the pressure input circuit. CR3858 and CR3859 prevent the sample and hold filter capacitors from becoming reverse biased by limiting the negative input voltage at -1.4 V. Pulling the cathode of CR3858 to -0.7 V ensures CR3859 is reverse biased even at slightly negative input voltages. This allows measurement of limited negative pressures.

U3636C and U3637B are comparator circuits that tell when to take the sample. Switches U3648A and B are intermediate sample and hold switches, U3648C and D are the output sample and hold switches, and C3874 and C3885 are the final storage capacitors that provide signal to the filter.

When the incoming pressure signal (from pin 1 of U3636A) is rising, pin 10 of U3636C rises. When the voltage pin 8 to go HI. Diode CR3872 conducts and charges C3870 to the value of the rising signal.

During this period of rising input signal, since pin 5 of U3638A is HI, pin 7 goes HI and switch U3648A closes. Thus, the rising signal at pin 10 of U3637C (voltage follower) charges C3873 to the input level.

As long as the input pressure signal is rising, pin 7 of U3737B is HI, pin 14 of U3637D is LO, and switches U3648B and C are open.

At the peak of the rise (systolic), C3873 will be charged to that peak level and a sample is taken.

When the presure signal starts to fall, pin 8 of U3636C goes LO because pin 9 is held at the highest input signal level by C3870 while pin 10 falls. Diode CR3872 turns off, pin 7 of U3638B goes LO, opening switches U3648A and D. The sample is now stored in C3873. Since there is no R associated with C3873 (except leakage currents), C3873 holds the highest value of the pressure signal.

As the pressure falls to the value remaining on C3881, pin 5 of U3637B falls, pin 7 goes LO, CR3882 turns on, and C3881 charges toward the pressure signal level. When pin 7 of U3637B goes LO, pin 14 of U3637D goes HI, closing switches U3648B and C. C3884 now charges toward the pressure input signal level via U3636B. At the same time, since U3648C is now closed, the voltage on C3873 is transferred to C3874 and the systolic sample is fed to the two-pole filter U3638D and associated circuitry. Since U3648D is open, the previous diastolic sample (on C3885) remains connected to the two-pole filter, U3647C and associated circuitry.

When the input pressure signal reaches the lowest value, C3884 is charged to that value.

As the input pressure now starts to rise, pin 7 of U3637B goes HI because pin 6 is held to the lower level by C3881 while pin 5 rises. Diode CR3882 turns off, pin 14 of U3637D goes LO, switch U3648B and C open, and the diastolic sample is now the voltage on C3884.

When the pressure rises to the value remaining on C3870 pin 8 of U3636C again goes HI, pin 7 of U3638B goes HI, switch U3648D closes, the voltage on C3884 is transferred to C3885, and the diastolic sample is fed to the two-pole filter U3647C and associated circuitry.

U3648A again closes and a new cycle starts.

Outputs from the two-pole filters are fed to the pressure alarm circuit and to a switch U3653C. This switch is controlled by the Systolic/Diastolic Selector. The switch output is fed to pin 4 of the Low-Priority Readout Selector, U3641.

The circuit responds to the peak and valley values (systolic and diastolic) while rejecting normal dicrotic notch level changes. The circuit will capture each systolic/diastolic peak, regardless of whether it is larger or smaller than the previous peak. This is due to action of R3870-C3870, R3881-C3881, and the intermediate sample and hold circuits.

The discharge rates of C3870 (systolic) and C3881 (diastolic) are such that the systolic and diastolic switching points are as shown in Fig. 3-11.

Resistors R3870 and R3881 ensure that whenever there is no pulsatile pressure (systolic minus diastolic = 0), all output levels decay to the static incoming pressure.

MEAN PRESSURE FILTER

The Mean Pressure Filter is a four-pole passive filter consisting of buffer amplifiers U3636D, U3637A, and associated components.

The four-pole filter is designed to provide an accurate mean value of the pressure signal with ripple less than 1 mmHg, and with reasonably fast response to large pressure changes.

The operational amplifiers provide impedance matching: U3636A presents a high-impedance load to the pressure signal attenuator and limiter circuit, and low impedance out to the first pole of the filter. Since the impedance of the second pole is too high to drive the third pole, U3637A provides the impedance interface. U3637A provides the low impedance interface to drive the readout selector multiplexer input, pin 6 of U3641.

6 READOUT SELECTOR CIRCUIT OPERATION

This circuit selects one of several analog signals as the DVM circuit input. U3650 and U3641 are analog multiplexers. Only one of them is allowed to pass a signal at a time. Each multiplexer has separate binary address lines. Table 3-2 shows the binary addresses and signals selected.

In all functions, except temperature, U3653A-10 is LO and the output of U3641 or U3650 is attenuated by a factor of 10 (path from U3653A-2 to U3653A-15 connected). In temperature U3653A-10 is set HI and the signal pases unattenuated.

U3640 decodes the binary address going to U3641 to provide control signals to readout blanking and overrange selection. When U3650 is enabled, U3640-11 steps HI. This selects a U3650 output of 8 or higher which in effect disables the decoding function of U3640.

When a RATE ALARM LIMIT or ZERO READOUT control is pushed, U3650 is enabled and U3641 is disabled (U3650-6 goes LO and U3641-6 goes HI). This allows alarm limits to be set or the pressure transducer to be zeroed regardless of the setting of the Readout Selector switch.

Based on the decoded information from U3640, U3631 selects the source of the overrange signal. When an overrange condition exists, U3631-3 goes LO. This LO enables the Rapid Update Trigger Generator through U3624B and Blanking Timing through U3642B.

Based on the decoded information from U3640, U3632 selects the source of the signal controlling digital display blanking. When U3632-3 goes LO, the digital display is blanked.

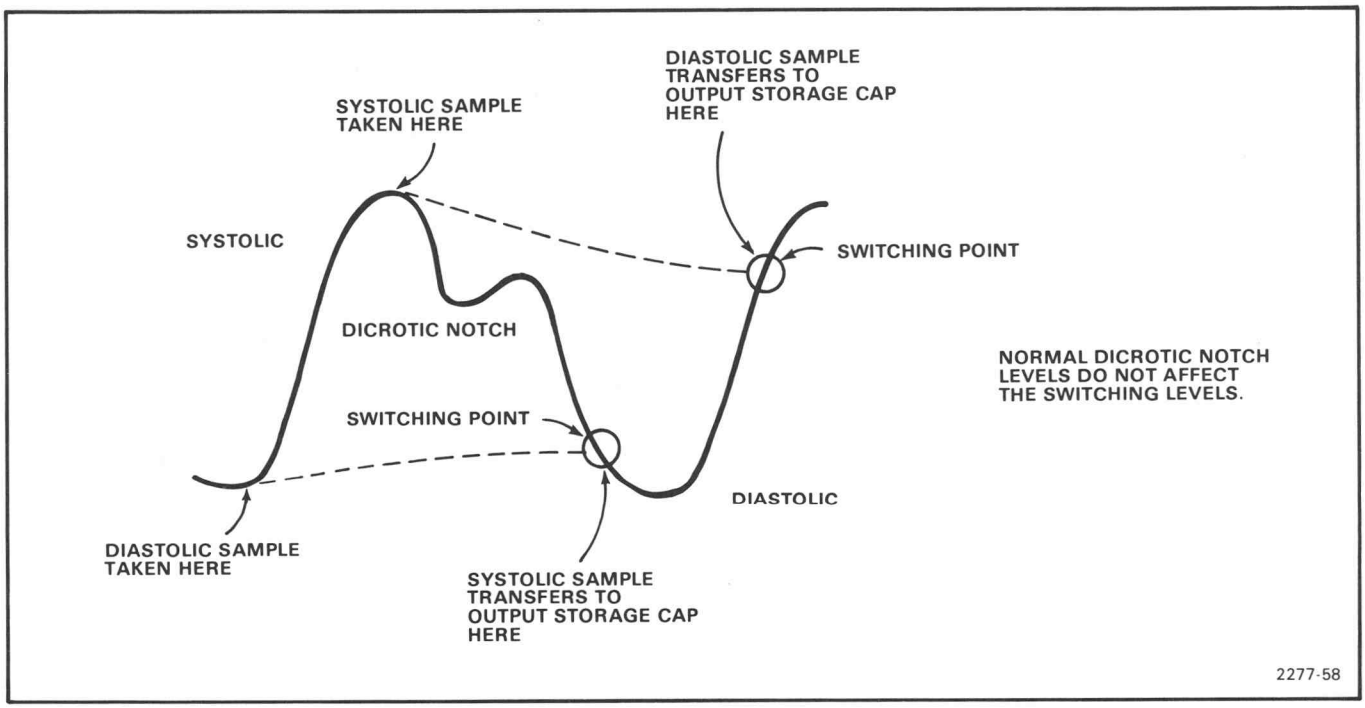


Fig. 3-11. Systolic/diastolic switching points.

TABLE 3-2
READOUT SELECTOR
ADDRESS ASSIGNMENTS

LOW PRIORITY PARAMETER	BINARY ADDRESS			DEC. EQUIV.
	U3641-11	U3641-10	U3641-9	
SYST/DIAS	1	1	1	7
MEAN	1	1	0	6
RESP	1	0	1	5
HEART	1	0	0	4
△T	0	1	1	3
A TEMP	0	1	0	2
B TEMP	0	0	1	1
NONE	0	0	0	0

HIGH PRIORITY PARAMETER[b]	BINARY ADDRESS			DEC. EQUIV.
	U3650-11	U3650-10	U3650-9	
[a]	1	1	1	7
[a]	1	1	0	6
[a]	1	0	1	5
HIGH HEART RATE LIMIT	1	0	0	4
LOW HEART RATE LIMIT	0	1	1	3
HIGH RESP RATE LIMIT	0	1	0	2
LOW RESP RATE LIMIT	0	0	1	1
PRESSURE READOUT ZERO	0	0	0	0

[a] Not used

[b] When a High Priority Parameter is selected, U3641-6 is set HI which inhibits the Low Priority Multiplexer output.

SYSTOLIC/DIASTOLIC SELECTOR

When SYST/DIAS is selected, the signal at U3641-4 passes to the DVM. The signal supplied to U3641-4 is selected by U3653C which is controlled by U3656B and associated circuitry. Figure 3-12 shows the logic signals generated during systolic-diastolic selection.

The sequence of events in the circuit is as follows:

1. Assume and initial condition where the Q1 and Q2 outputs of U3656B are LO. This sets the data input HI through U3634C. U3632-8 is also set HI causing the digital display to be blanked. Since Q2 is LO, U3653C pases the output of the systolic filter to the DVM through U3641.

2. The next sample pulse clocks U3656B-9. The HI on the D input is clocked to Q1 while Q2 remains LO.

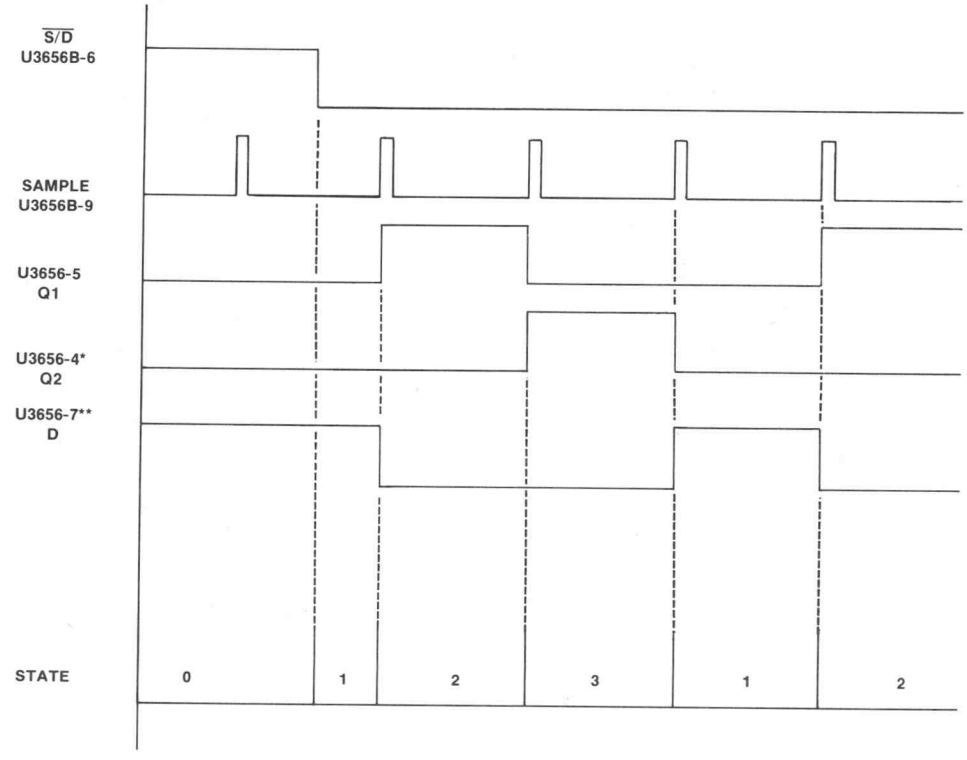
   This causes U3634C-10 to step LO which unblanks the digital display and sets the D input of U3656B LO. Since Q2 is still LO, U3653C still selects the output of the systolic filter.

3. The next sample pulse clocks the LO from D to Q1 and the HI from Q1 to Q2. The HI on Q2 keeps U3634C-10 LO Which keeps the digital display unblanked and holds the D input of U3656B LO. Since Q2 is HI, U3656C passes the output of the diastolic filter to the DVM.

4. The next sample pulse clocks LO's into both Q1 and Q2. This is the original assumed condition. The above sequence repeats.

The initial conditions assumed above are setup at the instant the SYST/DIAST button is pushed (by removing reset from U3656B-6). This ensures that the blank-systolic-diastolic sequence starts in the blank condition when SYST/DIAST is selected.

On each sample pulse U3652A is triggered. This provides a 100 ms blanking pulse at the beginning of each of the circuit states. Its function is to provide a slight blanked interval between the SYST and DIAST readings.



STATE
- 0 SYST/DIAST BUTTON NOT PUSHED
- 1 DISPLAY BLANKED-SYSTOLIC SELECTED (BUT NOT DISPLAYED)
- 2 DISPLAY UNBLANKED-SYSTOLIC DISPLAYED
- 3 DISPLAY UNBLANKED-DIASTOLIC DISPLAYED

*HI selects diastolic, LO selects systolic.

**HI blanks digital display.

2894-20

Fig. 3-12. Logic signals generated during systolic/diastolic selection.

SIGN ENABLE GATE

U3634A determines whether the sign information in the DVM is presented to the readout.

When temperature or pressure is being measured, a + or − sign must be displayed. For rate, the sign has no meaning so sign information is not displayed.

DECIMAL POINT SELECTION

When temperature is selected, the HI on pin 6 or 7 of U3649 causes a LO at pin 5. This signal is fed to the DVM via pin 29 of J3600 and enables decimal 3.

5 ALARM CIRCUIT OPERATION

HEART-RATE AND RESPIRATORY-RATE ALARMS

The respiratory-rate and heart-rate alarms operate in the same manner; therfore only the heart-rate alarm will be discussed.

WINDOW DETECTOR

This alarm circuit is simply a window detector. The output heart-rate converter is supplied to U3644-2 and 5. R3745 and R3749 set the high and low limits of the window.

When the heart-rate converter output is more positive than the HIGH Limit (U3643B-7), U3644B-7 steps HI setting U3645B-4 LO. When the heart-rate converter output is less positive than the LO Limit (U3644A-3), U3644A-1 steps HI setting U3645B-4 LO.

ALARM DELAY

In a non-alarm condition, U3645B-4 is HI which holds C3763 discharged through R3760 and CR3760.

When the window detector limits are violated, U3645B-4 steps LO which reverse biases CR3760. Now, C3763 charges through R3763. When C3763 charges to the threshold of Schmidt trigger U3623E, U3625-9 is set HI. If U3625-8 is also HI (alarm on), U3625-3 steps LO setting the alarm latch.

PRESSURE/PULSE ALARM

The pulse alarm has two modes of operation, the pressure/pulse mode and the pulse mode. They are individually discussed below.

PRESSURE MODE

When pressure is selected (front panel PULSE button out), U3619D-13 is set LO disabling the pulse mode of the circuit. Under non-alarm conditions, pin 2 of U3646A is more positive than pin 3 causing pin 1 to be LO. This holds C3784 discharged through CR3782 and R3784. Pin 5 of U3646B is held below ground so that pin 7 will be LO (No Alarm).

The current through R3782 produces a voltage drop across R3780 of about 65 to 85 mV depending on the output of the systolic filter. If the outputs of the systolic and diastolic filters are the same, pin 2 of U3646A will be less positive than pin 3 causing pin 1 to step HI. This reverse biases CR3782 allowing C3784 to charge through R3783.

When C3784 charges sufficiently, pin 5 of U3646B goes more positive than ground causing pin 7 to go HI (alarm). The 65 to 85 mV drop across R3780 requires that the output of the systolic filter be 65 to 85 mV (6.5 to 8.5 mmHg) more positive than the output of the diastolic filter to keep U3646B-7 LO (non-alarm).

PULSE MODE

When pulse is selected (front panel PULSE button in), the outputs of the systolic/diastolic filters fall to 0 V causing U3646A-1 to step HI (see Pressure Mode above). This holds CR3782 reverse biased.

Each time a pressure/pulse trigger occurs, U3619D-11 steps LO. This rapidly discharges C3784 through CR3783 and R3784. As long as triggers occur more frequently than about every 6.5 seconds,C3784 is not allowed to charge sufficiently to set U3646B-5 positive. Therefore U3646B-7 stays LO (no alarm). If the triggers cease (or are more than about 6.5 seconds apart), U3646B-7 goes HI.

RESPIRATORY EFFORT ARREST ALARM DETECTOR

This circuit senses when respiratory effort has ceased or is irregular.

NON-VIOLATION OPERATION

If the period between breaths is less than about 4 seconds, U3655B and U3652B are triggered on each inspiration trigger through U3624C. Since U3652B is continually retriggered, pin 9 stays LO and the alarm does not sound.

VIOLATION OPERATION

If the period between two successive breaths exceeds the time-out of U3655B (qualifier timer), U3655B-10 steps LO. This sets pin 9 of U3624C LO which prevents the respiratory-effort trigger from retriggering U3655B and U3652B. If U3652B times out before the reset criteria are met, U3652B-9 steps HI causing the alarm to sound through U3625.

VIOLATION RESET LOGIC

The violation reset logic consists of U3627B, U3656A, and U3653B. This circuit counts respiratory effort triggers and measures the time between the triggers to determine if the alarm should be reset (or prevented from sounding if U3652B has not timed out).

When the qualifier (U3655B) times out, the Violation reset logic is enabled by removing reset from U3627B (pin 13 is set HI). The sequence of events required to satisfy the reset criteria is as follows:

1. A respiratory-effort trigger occurs which triggers the breath-to-breath timer (U3627B). While U3627B is timing out, reset is removed from the breath counter (U3656A-B).

2. If another respiratory-effort trigger occurs before U3627B times out, U3627B is retriggered, U3656A is clocked, and U3656A-13 steps HI. In the 10 second setting of the DELAY switch, the HI on U3656A-13 passes through U3653B and sets U3655B-12 HI. In the 20 second setting of the DELAY switch, another breath must occur before U3627B times out. This clocks a HI into U3656A-12 which sets U3655B-12 HI through U3620B.

   If another respiratory effort trigger does not occur before U3627B times out, U3656A is reset and you must return to step one of this sequence.

3. When U3655B-12 is set HI, U3655B is triggered and its Q output steps HI. This sets U3624C-9 HI. Since the respiratory-effort trigger at U3624C-8 is still HI, U3624C-10 steps LO which retriggers U3655B and triggers U3652B. When U3652B is triggered, its $\overline{Q}$ output steps LO which turns off the alarm audio through U3625, U3634D, and U3633E.

4. When U3655B was triggered, its $\overline{Q}$ output stepped LO resetting U3627B. This caused the $\overline{Q}$ output of U3627B to go HI which resets U3656A. As a result, the positive-going pulse at U3655B-12 is very short in duration. Its duration is determined by the propagation delays in U3655B, U3627B, and U3656A.

ALARM LATCH LOGIC

Latch

The alarm latch consists of U3624A and U3624D. In the non-alarm condition, U3624A-3 is HI and U3624D-11 is LO. When an alarm condition is sensed, U3625-3 sets U3624D-13 LO. This reverses the state of the latch.

Latch Reset

U3624 A and C form an RS flip flop. See Table 3-3.

To reset the latch, U3624A-2 must be set LO (by turning on Q3670). This can be done by a negative-going pulse supplied through one of several series RC networks or by the reset timer (U3655A) which holds Q3670 on for about 45 seconds after the RESET pushbutton is pushed.

When Q3670 turns on, C3772 discharges and U3624A-2 is set LO. U3624A-2 is held LO as long as Q3670 is on plus about a one second delay delay determined by C3772-R3774.

TABLE 3-3
Truth Table for U3624A and C

$\overline{R}$ U3624-2	$\overline{S}$ U3624-13	Q U3624-11	$\overline{Q}$ U3624-3
0	0	1	1
0	1		
1	0	1	0
1	1	As previously set or reset.	

DISPLAY UNITS LOGIC

/m AND mm Indication

The /m and mm indicators are controlled by emitter followers U3630E and U3630D. When a Pressure Readout is selected, U3630D-10 is pulled HI allowing current to pass thru DS4060. When Heart Rate or Resp Rate is selected, U3630E-13 is pulled HI allowing current to pass thru DS4050.

°C and °F Indication

The °C and °F indicators are controlled by U3630A and U3630B. When a Temperature Readout is selected, U3633F-15 pulls up on the bases of U3630A and B to enable the circuit.

°F OPERATION. When °F is selected, U3649D-9 pulls the base of U3630A to about -6 to -6.3 V through CR3685. This holds U3630A off allowing emitter follower U3630B to supply current through DS4070.

°C OPERATION. When °C is selected, U3649D-9 is HI which reverse biases CR3685. The base of U3630A is pulled up thru R3685 turning on R3630A. While U3630A is on, current flows from ground through: the °C indicator, CR3686, U3630A, CR3687, and R3687. The voltage drop across CR3686 keeps the base-emitter junction of U3630B reverse biased.

DVM BOARD

DVM BOARD CIRCUIT FUNCTIONS

The DVM circuit accomplishes the following:

1. Converts analog input signals from the Conditioner board to digital signals which drive the gas-discharge readout elements.
2. Provides digital signal to blank digital display during certain intervals that could give an incorrect or unusable display.
3. Suppresses leading zeros.
4. Provides drive for decimal point and sign display.
5. Provides indication of parameter displayed, rate, pressure, and °C or °F temperature.
6. Provides power supplies for DVM and gas-discharge readout elements.

DVM AND DISPLAY CIRCUIT OPERATION

The basic DVM (digital voltmeter) circuit is comprised of U3921, U3974 and associated circuitry. Integrated circuit U3921 is a dual-ramp A/D Converter that containing digital logic circuitry that integrates, counts, and multiplexes. It also contains analog circuitry that provides operational amplifiers and comparators. Integrated circuit U3974 is a Decoder-Driver that converts the binary-coded-decimal (BCD) information from A/D Converter U3921, to the form necessary to drive the cathode segments of the gas-discharge display. The remaining circuits provide overrange-flash blanking inter-digit blanking, leading-zero suppression, and display drive operation.

A/D CONVERTER

Integrated circuit U3921 is basically an A/D ratiometric converter that measures an unknown input voltage (V_x) at pin 3 as a ratio of the reference voltage (V_{ref}) at pin 2. The full scale voltage is equal to the reference voltage (V_{ref}) applied to pin 2. Thus, a full scale voltage of 1.999 volts requires a reference voltage of 2.000 volts.

During each conversion cycle, the offset voltages of the internal amplifiers and comparators are compensated for by the system's autozero operation. The conversion cycle requires slightly more than 16000 clock periods that can be divided into six segments. The conversion cycle waveform at pin 6 is shown in Fig. 3-13. The six segments of this waveform are described as follows:

TABLE 3-4
Truth Table for BCD Output of U3921

Coded Condition of MSD	Q3[b]	Q2[a]	Q1	Q0
+0	1	1	1	0
-0	1	0	1	0
+1	0	1	0	0
-1	0	0	0	0

[a] Q2 is the sign bit: 1 = (+), 0 = (-).

[b] Q3 is the (1) digit bit: 1 = (1) displayed, 0 = (1) not displayed.

Segment 1.

The offset capacitor C3908 C_o, which compensates for the input offset voltages of the buffer and integrator amplifiers, is charged during this period. Also, the integrator capacitor is shorted. This segment requires 4000 clock periods.

Segment 2.

The integrator output decreases to the comparator threshold voltage. At this time a number of counts equivalent to the input offset voltage of the comparator is stored in the offset latches for later use in the autozero process. The time for this segment is variable, and less than 800 clock periods.

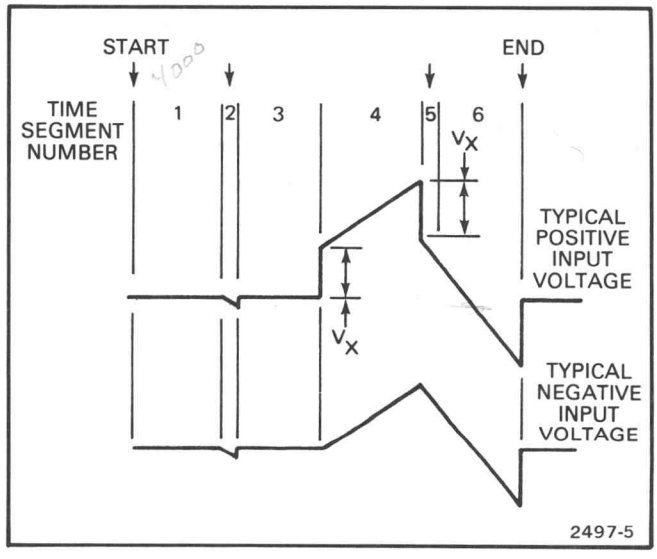


Fig. 3-13. Integrator waveform at pin 6 of U3921.

Segment 3.

This segment of the conversion cycle is the same as Segment 1.

Segment 4.

Segment 4 is an up-going ramp cycle with the unknown input voltage (V_X) at pin 3 as the input to the integrator. Figure 3-14 shows the equivalent configuration of the analog section of U3921. The actual configuration of the analog section is dependent upon the polarity of the input voltage during the previous conversion cycle.

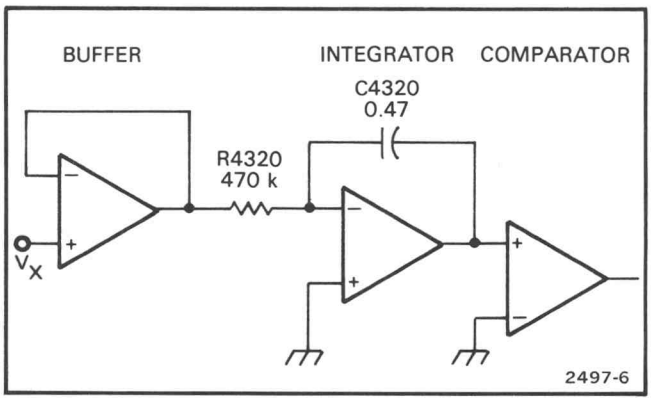


Fig. 3-14. Equivalent circuit diagram of the analog section of U3921 during Segment 4.

Segment 5.

This segment is a down-going ramp period with the reference voltage as the input to the integrator. Segment 5 of the conversion cycle has a time equal to the number of counts stored in the offset storage latches during Segment 2. As a result, the system zeros auomatically.

Segment 6.

This is an extension of Segment 5. The time period for this portion is 4000 clock periods. The results of the A/D conversion cycle are determined in this portion of the conversion cycle.

An end-of-conversion (EOC) pulse is available at pin 14 of U3921 after each conversion cycle. The EOC pulse width is equivalent to one-half the period of the system clock at pin 11 (CLK O).

The results of a conversion cycle will be stored in the output latches if a display update pulse is applied to pin 9 prior to segment 5. The resulting information stored in the latches are multiplexed out through the digit select outputs at pins I9, I8, I7 and 16 (i.e., DS1, DS2, DS2 and DS4 respectively). The digit select output is high when the respective digit is selected. The most significant digit DS1 turns on immediately after an EOC pulse followed by the remaining digits, sequencing from most-significant digit (MSD) to least-significant digit (LSD). An interdigit blanking time of two clock periods is included to ensure that the binary-coded decimal (BCD) data from the Q output (pins 20, 21, 22 and 23 of U3921) has settled. The multiplex cycle rate is about 4000 Hz. Relative timing between the digit select (DS) output and the EOC signals is shown in Figure 3-15.

The BCD data outputs at pins 20, 21, 22 and 23 (QØ—Q3) are ready to be multiplexed on immediately after an EOC pulse occurs. Three full digits of information are available during DS2, 3 and 4 output periods, while during DS1 output period, the 1/2 digit and polarity are available.

When pin 19 (DS1) goes HI, the code on the BCD data output Q2 determines polarity and output Q3 determines whether a 1 or nothing is displayed in the MSD location (A1) on gas-discharge readout element U4010. Q2: HI=positive, LO=negative; Q3: HI=MSD of "0", LO=MSD of "1".

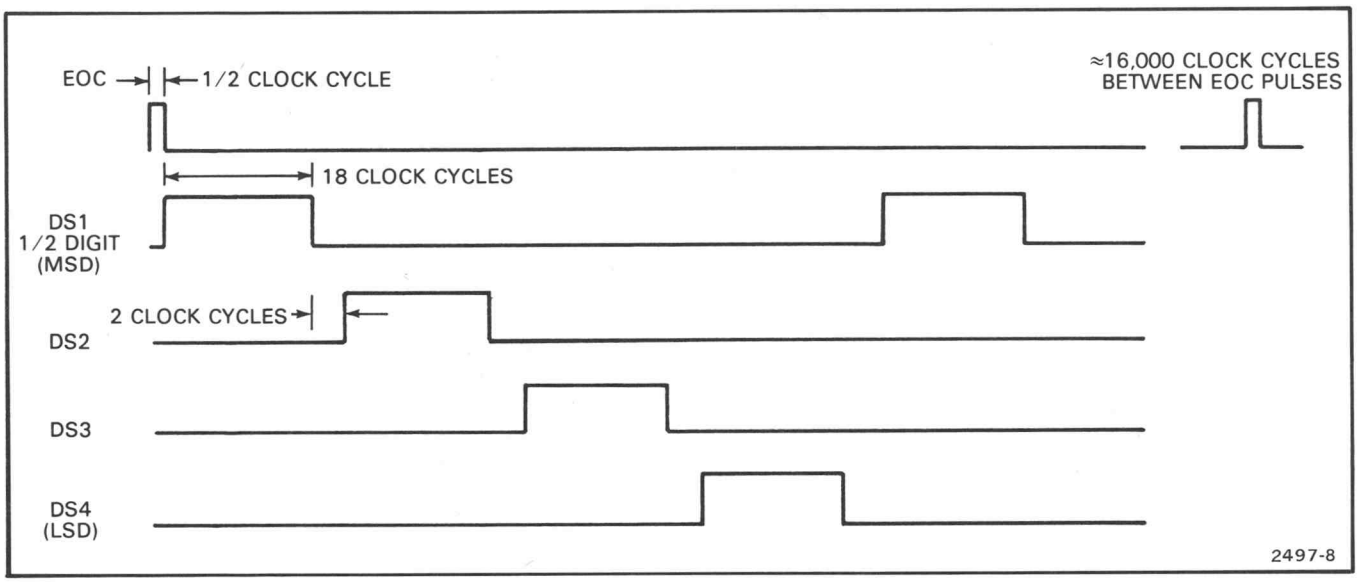


Fig. 3-15. Digital select timing diagram.

DIGIT-SELECT OUTPUT & INTERDIGIT BLANKING

The multiplex frequency at U3921 is divided by 32 to allow proper operation of the readout devices.

U3913 is clocked to latch the binary-coded information from U3921 pins 20 through 23 to the Decoder Driver U3974. See timing diagram Figure 3-16.

A digit is selected when the corresponding outputs from U3924A and U3921 are HI. For example, when pin 5 of U3924A is HI and pin 18 of U3921 goes HI pin 3 of U3943 goes LO and transfers Digit 2 data from U3921 pins 20, 21, 22, and 23 to U3974 inputs A,B, C,and D. Since pin 5 stays HI for 8 occurrences of DS1, data for each digit is latched into U3913 8 times before the next digit is selected.

Each time DS1 (U3921, pin 19) goes HI, U3944A is clocked. Every fourth time DS1 goes HI, U3944B is enabled which increments the output of U3944B. The Q1 and Q2 outputs of U3944B set up addresses for U3924A and U3924B. Every eighth time DS1 goes HI U3924A inputs are incremented. The multiplex frequency at U3921 is thus divided by 32 to allow proper operation of the readout devices. U3924A outputs are incremented in direct response to their inputs; however to provide inter-digit blanking, pin 15 of U3924B is held HI for the first 2 of the 8 DS1 occurrences. This causes all outputs of U3924B to be LO, turning off all the anode Driver transistors. This occurs whenever both inputs to U3953A are LO. Blanking the display briefly between digits allows time for deionization of the gas in the readout devices to prevent appearance of streamers (blue glow) or partially lit segments.

ANODE DRIVERS

The display anodes AD1 through AD4 are driven from Anode Driver circuits Q3907 through Q3938.

The Anode Drivers are driven by the DS outputs from Multiplexer U3924. The Anode Driver circuits are identical so only one is described here.

When the 0 output from Multiplexer U3924B goes HI indicating that DS1 is going to be displayed, Q3927 turns on. This pulls Q3927 collector down far enough to cause Q3907 to saturate. When Q3907 saturates, the gas-discharge display anode at location A1 is at about +165 volts.

DECODER-DRIVER

Decoder-Driver U3974 converts the binary-coded decimal (BCD) information from the A/D Converter via the Digit Data Latch to the form required to drive the cathode segments of the 7-segment gas-discharge display.

The BCD outputs (Q0 through Q3) from the A/D Converter are latched by U3913 and fed to the A, B, C and D inputs of the Decoder-Driver. When turned on by a binary-coded number at the A, B, C, and D inputs, the appropriate# segment drivers pull toward ground and current is controlled to each display segment. The current outputs are set for the appropriate ratio to light the display segments evenly, since some segments are larger than the others.

When the display segments are not on, the cathode segments are set at about +75 volts by resistor pack R3975A through F. Resistor R3949 at the programming input (pin 3) sets the average current for all the outputs to control the display brightness.

Ripple blanking input and output operates in conjunction with leading zero suppression which is described in the following discussion.

LEADING-ZERO SUPPRESSION LOGIC

Integrated circuits U3953B, U3973E, U3954A, and U3973D provide leading zero suppression. A zero is suppressed if there are no none-zero numbers to the left. The zero to the left or right of the decimal point is not suppressed.

If a 1 is displayed in digit location A1, pin 23 (Q3) of the A/D Converter, U3921, is LO. This condition puts a LO on the data input, pin 5,of U3954A when pin 12 of U3924B goes HI to display DS1, the clock input, pin 3 of U3954B goes HI, pin 13 of U3954A is LO which puts a HI on the ripple blanking input, pin 5, of Decoder Driver, U3974 and no zero suppression (blanking) occurs.

If a 1 is not displayed in digit location A1, pin 5 of U3954A is HI. When the output at pin 12 of U3924B clocks U3954A setting pin 1 HI. This puts a LO on the ripple blanking input, pin 5, of Decoder Driver U3974 causing any zero that is decoded from the A, B, C, and D inputs to U3974 to be blanked.

Certain other situations occur that require cancelling the zero suppression condition when a 1 is not displayed in digit location A1. For example, when temperature is displayed, a LO is present at pin 26 of P3900 which puts a HI at pin 9 of AND-OR-INVERT gate U3953B.

Pin 12 of U3953B also goes HI to satisfy the AND condition when pin 6 of U3924A (DS3) goes HI. Flip-flop U3954A is then reset by the HI at pin 4. Thus, pin 1 goes LO which puts a HI at pin 5 of U3974 and no zero suppression occurs. This condition insures that, in the temperature mode, the digit at location A3 just prior to the decimal will always be displayed even if it is a zero. Another zero-suppression cancel command occurs when pin 7 of U3924A goes HI and resets U3954A. Thus, pin 5 of U3954A goes HI as described previously, and the last digit is never blanked even if it is a zero.

The last zero-suppression cancel command occurs when a 1 is not being displayed in digit location A1 while the digit displayed in location A2 is other than a zero. For example, if a 1 is not being displayed in location A1, U3954A is set as described previously and all succeeding zeros would be blanked. However, if the digit displayed in

location A2 is other than a zero, the zero suppression condition is cancelled. This is accomplished when pin 18 (DS2) of U3924Bgoes HI and the ripple blanking output from pin 4 of U3974 also goes HI which resets flip-flop U3954A. The ripple-blanking output from pin 4 of U3974 is HI when the digit at location A2 is other than a zero. With U3954A reset, pin 5 of U3974 is HI and the zero-suppression condition is cancelled.

DISPLAY UPDATE (DU) AND SAMPLE

In normal operation the display information is updated once per second. The clock frequency of U3921 has been set to force it to make 20 conversions per second. U3962A, and B divide the 20 EOC pulses down to one per second. In rapid update mode, the display information is updated 5 times per second.

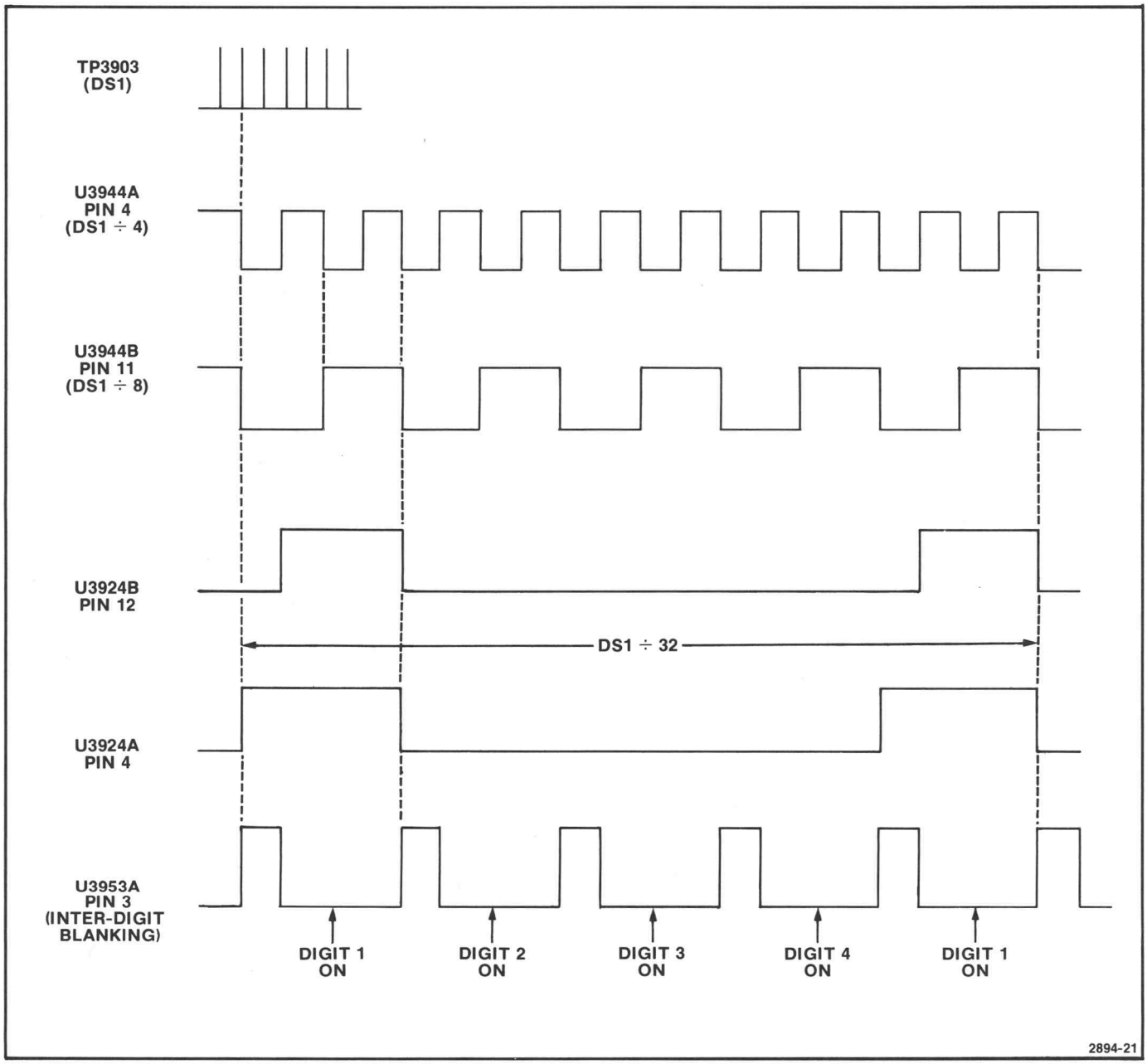


Fig. 3-16. Timing diagram for digit select and inter-digit blanking.

Assuming a Sample pulse has just occurred, U3962A and B will have just returned to count 0 (see Fig. 3-17), the next EOC pulse will clock U3962A to produce a positive output at pin 12 of U3954B. This output will produce a Display Update signal at pin 9 of U3921 which causes the results of the **next** conversion to be latched in U3921. U3969A will continue to count EOC pulses. The tenth pulse will produce an output at pin 6 which will enable U3962B. U3962B will divide by 2 (20 EOC pulses) and produce an output at pin 11. This will clock U3954B returning its outputs to the original level. U3962A will also be returned to its original state at this time and a Sample signal will occur at P3900 pin 10.

At this point, 19 EOC pulses have occurred since the last display update signal. After 1 more EOC pulse, display update will occur as before (after 19 plus 1 or 20 EOC pulses). display update will occur once per second.

This counting cycle will continue unless Syst/Diast operation is selected, in which case the Sample output P3900 pin 10 is then used to switch the Syst/Diast selector on the Conditioner board. When the selector switches the signal input to the DVM, a negative signal is also applied to the $\overline{\text{Update}}$ input P3900. This resets the EOC counters so that 2 conversions are made before the display information in U3921 is updated. 18 more conversions are made and then another Sample signal is generated to switch the Syst/Diast selector. This produces another Update input at P3900 pin 22 and the sequence is repeated. Display update signal to pin 9 of U3921 is generated by the first EOC pulse after $\overline{\text{Update}}$ occurs.

The reason for 2 conversions being made before data is updated is that U3921 requires one conversion to recognize a change of polarity and one to measure the input signal level at pin 3. Thus 2 conversions are always required in case the signal has changed polarity.

BLANKING LOGIC

The blanking signal from the readout switching and pressure converters on the Conditioner board is used in the DVM circuit to blank the readout display during systolic/diastolic operation and overrange conditions. Blank time between systolic and diastolic readings is approximately 100 ms. The time required by the DVM circuit to make the required 2 conversions is also approximately 100 ms. U3976B and D are connected so that whichever of these 100 ms periods is longer will control the total blank time. No blanking will occur unless the blanking signal at U3976B-6 is low.

SIGN, DECIMAL, AND 1/2-DIGIT DRIVERS

Transistors Q3942, Q3971, Q3977, Q3986, Q3987, and Q3988, are cathode-current drivers for the plus (+) and minus (–) signs, the decimal point, and the 1 displayed at digit location A1. When the base of the driver transistors is pulled HI (to +5 volts) the driver emitter resistor sets the collector current and turns on the appropriate display cathode segments.

For example, if the display is supposed to be +1000, the binary code from the Q outputs of U3913 for a +1 display at digit location A1 is 0100 (refer Fig. 3-4). The LO at Q3 of U3913 turns on Q3987 and lights the 1 at digit location A1. The level at Q2 of U3913 determines the displayed polarity at digit location A1. In this case, binary code 0100 at the Q outputs of U3913 means the level at Q2 is HI which turns on Q3986 and lights the plus (+) sign. A LO at Q2 turns on Q3977 through inverter U3976A and lights the minus (–) sign at location A1.

Transistor Q3942 disables the digit display cathodes at location A1 except when temperature is displayed. All the cathode drivers for digit location A1 have their

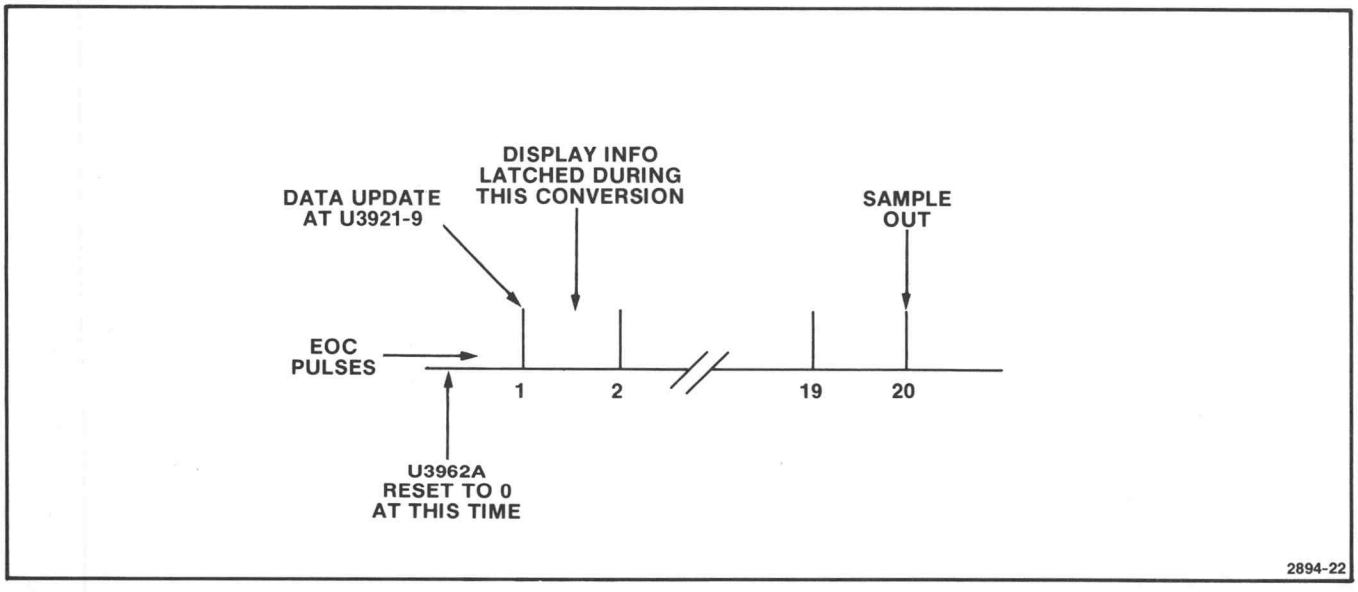


Fig. 3-17. Data update sequence.

emitter current control resistors returned to the collector of Q3942 instead of to ground. Transistor Q3942 is turned on only by a HI at pin 4 of U3924A (DS1) unless Q3942 is held off by a HI at pin 2 of P3900. Quiescently, the Cathode Drivers for digit location A1 are disabled until Q3942 conducts and pulls the Cathode Driver emitter resistors to ground.

Transistor Q3988 and associated circuitry compose a decimal point driver that is enabled when pin 6 of U3924A (DS3) goes HI (i.e. a digit is selected for location A3) and pin 8 (DP2) of P3900 goes LO. The decimal point is used only for the temperature readout.

MAIN BOARD

MAIN BOARD CIRCUIT FUNCTIONS

The Main board has the following functions:

1. Power supplies—ac, battery, and converter.
2. Interconnection of other boards.
3. Master clock.
4. Vertical trace chopping of ECG and chopper on Pressure/Pulse board.
5. Vertical amplifier for the crt trace.
6. Trigger selection—ECG or Pressure/Pulse.
7. Sweep trigger.
8. Sweep generator.
9. Horizontal amplifier for crt trace.
10. Alarm audio.
11. Beat audio.
12. ECG/RESP lead test.

INTERCONNECTION

The Main board provides interconnection and power supplies for the other circuit boards in the 413A. To prevent ground loops, there are 6 grounding paths in the 413A. All of these meet at C4267 at the large ground lug. (Ground 5 goes to a small ground lug.) All circuit grounds ultimately connect to instrument chassis at the rear center Main board mounting screw.

ECG, Respiration, Pressure/Pulse, Dvm, and High Voltage boards are mounted directly on the Main board. The other boards—Digital Display, Readout Switch, Rate Alarm Control, and Sweep Switch—the front panel, the battery pack, and battery conditioner connect to the Main board via ribbon cables.

MASTER CLOCK AND DIVIDERS

The master clock and dividers consist of a 400 kHz crystal oscillator and two divider chains. The first divider chain provides 50 kHz for the Respiration board and 200 kHz for the ECG board. The second divider chain provides 4 kHz for chop blanking and 2 kHz for trace switching.

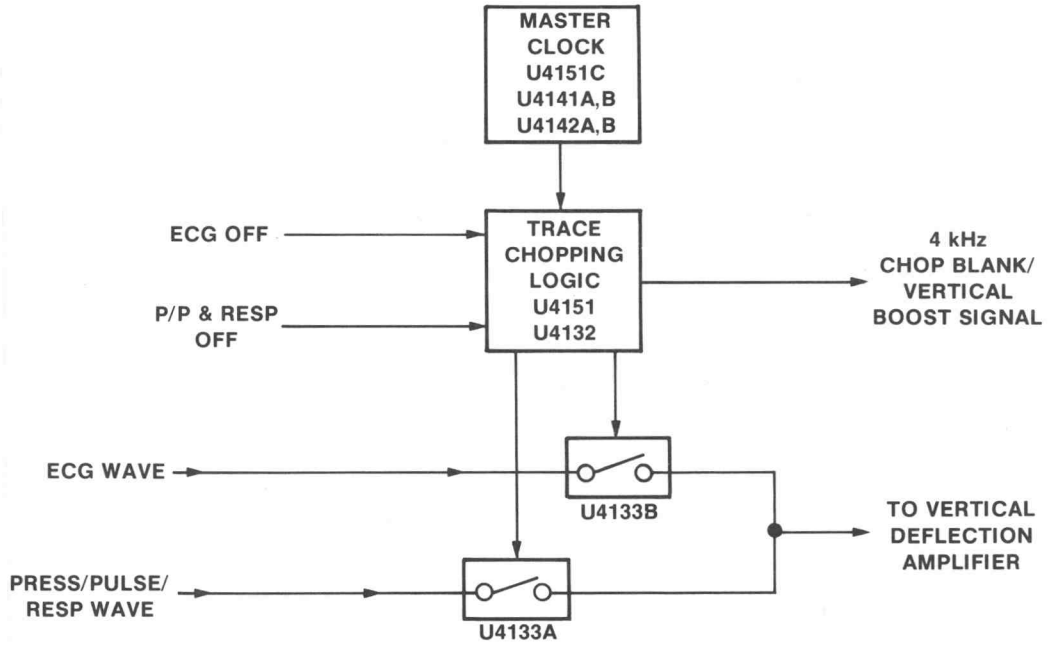
The first divider chain is simply U4142B which is a 4 bit binary counter. The second divider chain consists of 3 stages. U4141B is used as a divide-by-five with 80 kHz output, consisting of pairs of pulses. U4141A is a divide-by-ten with output consisting of a 20% duty cycle pulse at 8 kHz. 50% duty cycle is established by U4142A which is used as a divide-by-two and divide-by-four with output of 4 kHz and 2 kHz, respectively.

VERTICAL TRACE CHOPPING

ECG Off and Pressure/Pulse & Respiration Display Off Logic signals determine whether channels are displayed alone or simultaneously. When both channels are selected, a 2-kHz clock signal drives electronic switches (U4133A and B) which chop between the two channels.

A 4-kHz crt blanking signal is produced during the channel-switching interval to eliminate switching transients from the display. The Vertical Boost circuit provides voltage for rapid change of deflection-coil current during the channel-switching interval.

Transmission gates U4133A and B close to connect the ECG or pressure/pulse respiration waves to the Vertical Deflection Amplifier. A HI at pin 13 of U4133A connects the pressure/pulse respiration wave to U4123. A HI at pin 5 of U4133B connects the ECG wave to U4123. When the pressure/ pulse/respiration and ECG channels are on at the same time, U4133A and B are closed and opened alternately by the 2 kHz clock signal to display channels simultaneously. See Figure 3-18 for switching logic.



	ECG and PRESS/PULSE/RESP DISPLAY ON	ECG DISPLAY ON ONLY	PRESS/PULSE AND/OR RESP DISPLAYS ON ONLY	ALL DISPLAYS ON
ECG OFF SIGNAL	LO	LO	HI	HI
PRESS/PULSE & RESP OFF SIGNAL	LO	HI	LO	HI
U4151B PIN 4	⎍⎍⎍	HI	LO	LO
U4132D PIN 11	⎍⎍⎍	LO	HI	LO
U4151A PIN 3	⎍⎍⎍	LO	⎍⎍⎍	LO
ECG WAVE GATE U4133B	OPEN & CLOSED ALTERNATELY AT 2 kHz CLOCK RATE	CLOSED	OPEN	OPEN
PRESS/PULSE/RESP WAVE GATE U1632A		OPEN	CLOSED	OPEN
4 kHz CHOP BLANK/ VERTICAL BOOST U4132A	⎍⎍⎍⎍⎍	LO	LO[1]	LO

[1] 4 kHz chop blanking and vertical boost signal present when press/pulse and respiration channels displayed simultaneously.

2894-23

Fig. 3-18. Trace-switching logic.

8

VERTICAL CIRCUIT OPERATION

The Vertical Deflection circuit amplifies ECG or pressure/pulse respiration waves, selected by the Trace-Switching Logic circuit, and drives the vertical deflection coil.

VERTICAL DEFLECTION AMPLIFIER

Integrated circuit U4123 and its associated circuitry, is basically a voltage follower configuration of an operational amplifier as in Figure 3-19A. Output current of this stage is determined by R4147, which loads the amplifier output as shown in Figure 3-19B. The vertical deflection coil is then added in series with the amplifier output as in Figure 3-19C. Thus, Figure 3-19C is the basic circuit for the vertical amplifier.

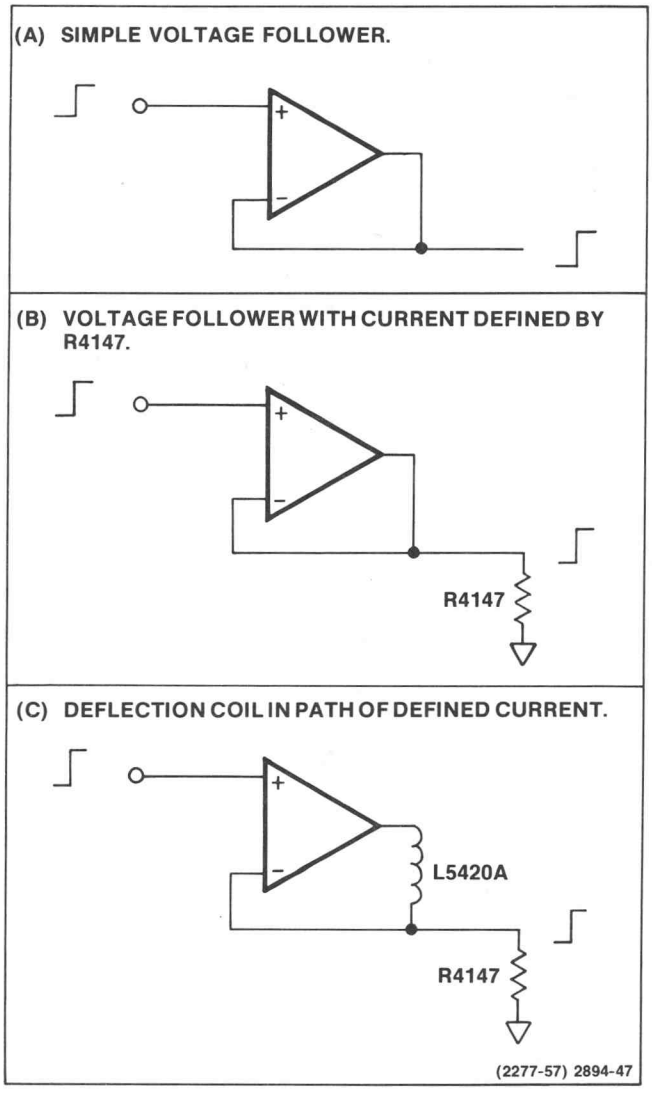


Fig. 3-19. Vertical-deflection amplifier basic circuit concepts.

Transistors Q4127, Q4128, Q4145, and Q4146 are current boosters for the operational amplifier output. Q4125 and Q4135 provide the interface between the output of U4123 and the boost transistors, and allow voltage swing up to +35 volts.

DS4123 and DS4125 are light-emitting diodes which limit the input voltage for U4123 to + or −1.5 volts. This prevents the amplifier from establishing unnecessarily high current levels in the vertical deflection coil.

Some rapid changes at the input of U4123, such as the chop transition from one trace to another, cannot be followed instantaneously by the output. This can create a substantial difference between the input and the feedback. Therefore, the bi-directional clamp, Q4134 and Q4144, limits Q4125 and Q4135 collector current to a value that is usable by the output stage.

A 70-microsecond vertical boost pulse from U4121A causes Q4126, Q4128, Q4136, and Q4137 to switch the amplifier power supply from + and −7 volts to + and −35 volts. This higher voltage decreases the time required for the current to change in the vertical deflection coil.

The chop blank pulse, occurring at the same time that the trace is switched, triggers 20-microsecond one shot multivibrator U4121B. The vertical boost multivibrator, U4121A, can be triggered during the 20 microsecond LO at pin 1. If the amplifier begins to overload due to the chop transition, Q4134 and Q4144 are turned on. This turns on Q4124, causing pin 3 to go HI and release the reset. Pin 2 goes HI (after C4117 discharges) to trigger U4121A.

The resultant 70-microsecond pulse at pin 6 of U4121A turns on Q4126, Q4128, Q4136, and Q4137 to increase the output amplifier collector voltage to +35 and −35 volts.

Capacitor C4117 delays resetting of U4121A after boost is no longer needed. Transients, which momentarily turn off Q4124, cannot cause pin 3 of U4121A to go LO until C4117 has charged through R4120, CR4120, and R4122 or R4121 and CR4121 and R4120.

CR4122 prevents U4121A from resetting during the first 20 μsecs of boost interval. During this interval, C4117 may not have time to completely discharge and transients could falsely end the boost interval.

8

HORIZONTAL CIRCUIT OPERATION

The Horizontal circuit consists of a Trigger Selector, a Sweep Trigger circuit, a Sweep Generator, and a Horizontal Amplifier to drive the horizontal deflection coil.

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The Sweep Trigger circuit produces an approximate 5 millisecond selected trigger signal. ECG or Pressure/Pulse Trigger signal is selected depending on the status of the ECG channel.

The sweep is triggered at speeds of 50 and 100 mm/second, free running at 12.5 and 25 mm/second. If the trigger pulses stop for about 4 seconds, the Sweep Trigger Logic circuit gates on the Sweep Generator to provide a free-running baseline trace.

The Sweep Generator produces a sawtooth signal that is amplified by the Horizontal Amplifier to drive the horizontal deflection coil.

TRIGGER SELECTOR

Gates U4133C and U4133D select either the ECG or Pressure/Pulse Trigger signal. When the ECG channel is on, U4133C is closed (pin 6, HI) and U4133D is open (pin 12, LO), selecting the ECG Trigger signal. When the ECG channel is off U4133C is open (pin 6, LO) and U4133D is closed (pin 12, HI) selecting the Pressure/Pulse Trigger signal.

SWEEP TRIGGER

The selected trigger signal from U4133C or D triggers U4124A to produce a 5 millisecond selected trigger pulse. When pin 9 of U4153A goes LO and the sweep retrace has ended, a sweep will start. If pin 9 is held LO, a new sweep will be started at the end of each retrace cycle. Pin 9 goes LO whenever any of the three inputs in 1, 2, or 8) go HI.

Pin 1 of U4153A goes HI (through R4172 to +7 V) whenever P4197 is removed. Also, pin 1 goes HI at selected sweep speeds when the appropriate resistor (R4240 through R4243) is removed.

Pin 2 of U4153A goes HI for 5 milliseconds each time a selected trigger pulse is produced by U4124A.

Pin 8 of U4153A goes HI to free run the sweep if no selected triggers occur for at least 4 seconds.

U4143 is a counter which is clocked by the 2-kHz clock signal and is reset each time a 5-millisecond selected trigger pulse occurs. If the selected trigger pulses stop, U4143 is not reset and counts for about 4 seconds until pin 3 goes HI and stops the clock pulses through U4153C. With no clock pulses, U4143 pin 3 is held HI until the selected trigger pulses resume, which resets U4143, causing pin 3 to return LO. As long as pin 3 of U4143 remains HI, pin 8 of U4153A is HI and the sweep is free-running.

A flip-flop (U4134A) widens the 5-millisecond selected trigger pulse to approximately 68 milliseconds for beat tone and for RATE OUTPUT at the rear panel.

Each time a 5-millisecond selected trigger pulse occurs, U4134A pin 2 is set LO and counter U4143 starts counting. After 128 counts, U4143-13 goes HI and clocks U4134A, which causes pin 2 to go HI. Thus with each trigger pulse a 68-millisecond LO pulse is produced at pin 2 of U4143A. This turns off CR4169 and allows the 2-kHz clock sigal to pass through CR4168 to the Audio Amplifier for 68 milliseconds.

The 68-millisecond trigger pulse at pin 2 of U4134A also passes through amplifier Q4101/Q4111. This produces a +5.5 volt, 68-millisecond pulse capable of providing about 12 milliamperes to the rear panel RATE OUTPUT jack.

SWEEP GENERATOR

The sawtooth sweep signal is produced by counter U4146 and R-2R resistive ladder network R4218. U4146 is clocked by the appropriate clock pulse as selected by the SWEEP SPEED mm/SEC switch.

As U4146 is clocked, its output counts in the normal binary fashion. Due to the design of the R-2R ladder, each additional count produces an increase in the current into the Horizontal Deflection Amplifier. Thus, a stairstep current ramp is produced which drives the horizontal deflection coil to move the electron beam across the crt screen.

At the 512th count, pin 14 of U4146 goes HI (ground), turning off Q4169 and triggering one shot U4124B. U4124B produces a 20-millisecond pulse which blanks the crt, sets U4134B pin 13 HI, and inhibits gate U4153B (pin 4 & 5 goes HI) from passing further triggers. The HI at pin 13 of U4134B turns on Q4178, causing pin 11 of U4146 to go HI and reset the counter to zero.

At the end of the 20 millisecond pulse, pins 4 and 5 of U4153B go LO. If pin 3 is also LO due to a trigger pulse or to being held LO for a free-running sweep, pin 6 of U4153B will go HI. This resets U4143B, causing pin 11 of U4146 to go LO and allowing another sweep to start.

Sweep speeds are determined by the rate at which U4146 is clocked. The 2-kHz clock signal at pin 10 of U4144 is counted down to 500 Hz, 250 Hz, 125 Hz, and 62.5 Hz at the Q2, Q3, Q4, and Q5 outputs respectively. The SWEEP SPEED mm/SEC switch selects the appropriate clock pulse from U4144 to clock U4146.

HORIZONTAL DEFLECTION AMPLIFIER

U4136B and its follower transistors, Q4155 and Q4165, compose a conventional inverting type operational-amplifier circuit. The deflection coil is operated in the voltage mode so that the coil current is determined by the voltage across the coil divided by the coil resistance.

The amplifier impresses a negative-going sawtooth voltage at pin 2 of P4114 (deflection-coil plug). This voltage is fed through R4123, RT5420, and R4125 to the opposing half of the Horizontal Deflection Amplifier (U4136A, Q4154, and Q4164). The sawtooth is inverted through U4136A which impresses a positive-going sawtooth at the other side of the horizontal deflection coil.

Thermistor RT5420 compensates for changes in resistance of the horizontal deflection coil wire due to internal temperature changes.

8 AUDIO AMPLIFIER CIRCUIT OPERATION

The Audio Amplifier provides audible beat and alarm tones. Both tones are produced from the 2 kHz clock signal which is gated into the Audio Amplifier through CR4168 and CR4173, respectively.

The beat tone is produced when the trigger pulse from pin 2 of U4134 turns off CR4169 and allows the 2-kHz clock signal to pass through CR4168 for 68 milliseconds. This signal passes through the BEAT LOUDNESS control which sets the signal level into U4145.

The alarm tone is produced when the $\overline{\text{Audio}}$ logic signal goes LO (alarm detected), turns on CR4173, and allows the 2-kHz clock signal to pass to the ALARM LOUDNESS control to U4145.

ECG/RESP LEAD TEST

The ECG Lead Test circuit provides approximate 117-beats-per-minute output pulses for checking patient cable continuity and ECG circuit operation.

The pulses are initiated by the Q7, Q8, Q9, and Q10 outputs of U4144. A negative-going pulse occurs at the RA lead check terminal (pin 1 of P4116) whenever all four outputs of the counter are LO. When the outputs go LO, diodes CR4185, CR4186, CR4187, and CR4188 turn off and CR4189 turns on, producing the ECG LEAD CHECK voltage across divider R4189/R4191/R4193 between −12 volts and ground. Outputs are as follows: RA to LL, 1.5 millivolts; RA to LA, 1 millivolt; LA to LL, 0.5 millivolts.

The duration of the pulse is determined by how long the Q7 output of the counter remains LO (about 32 milliseconds).

Capacitor C4189 gives the output pulses the appropriate rise and fall times to activate the QRS detector but not the pacer detector.

The Resp Lead Test circuit consists of a switched impedance in series with LA and RA.

Q4173 (V-FET) is used as a switch to place R4194, 374 Ω in parallel with R4192, 20 Ω. The parallel combination yields 19 Ω (a change of 1 Ω).

With P4154 jumpered in the normal position, the gate of Q4173 is connected to the Q12 output of U4144, 29 bpm. With P4154 jumpered in the CVA position, the Resp lead test impedance falls 64 ms after each time the ECG lead test waveform starts. This feature may be of some value in troubleshooting the CVA detector on the Respiration board.

The zener diodes CR4191, CR4193, and CR4195 all are for protection against static discharge.

9 CRT CIRCUIT OPERATION

CRT BIAS AND BLANKING

The crt has electrostatic focus and electromagnetic deflection. The cathode is directly heated for good efficiency and fast warmup. The intensity is fixed because beam current is maintained constant. Focus adjustment R4440 is provided to obtain best spot focus.

V5440 (crt), Q4442, and Q4446 form a feedback circuit which sets the crt grid voltage to any required level so that the crt cathode current is held constant at about 6 microamperes (through R4456 and R4455) for single trace, or about 16 microamperes (through R4454, R4456, and R4455) for dual trace (ECG displayed with either or both pressure/pulse and respiration).

The beam current is supplied from only R4455 and R4456 when either ECG channel or pressure/pulse and respiration channel is off. When ECG and another or all three channels are on, CR4453 and CR4454 are off and CR4456 is on, and additional beam current is supplied through R4454.

Crt beam current is off during sweep retrace and multi-trace switching intervals. This is accomplished by positive-going blanking pulses applied through CR4451 and CR4452 to the base of Q4446. The positive pulses turn off Q4446 and Q4442, allowing the collector of Q4442 to go to −50 volts and cutting off the crt beam current. The crt cathode remains near ground potential due to C4446.

Crt anode voltage (≈3400 V dc) is generated by ×6 multiplier fed by 600 V ac.

9

POWER SUPPLY CIRCUIT OPERATION

The Power Supply operates from either a 115 or 230 V ac power source or from the internal battery. When the mains-power plug is connected to 115 or 230 V ac, the battery charging circuit is activated unless the battery conditioner is operating.

The Battery Status circuit monitors the battery voltage to operate the dual LED BATTERY indicator and shut down the monitor when the voltage drops to approximately 4.6 volts.

The other supply voltages are regulated by means of a primary regulating circuit, referenced to the +5 volt supply.

AC-LINE VOLTAGE INPUT

The mains power transformer, T5420, has two balanced primary windings. The windings are switched in parallel for 115 V mains operation and switched in series for 230 V mains operation by the rear panel LINE VOLTAGE RANGE switch. The transformer has two secondary windings. One supplies voltage through CR5423 to operate relay K4260 and the Battery Charger circuit. The other supplies power to the Power Supply Converter.

When the mains plug is connected to the proper outlet, K4260 closes to switch the power source from battery to mains and also the Battery Charger circuit is activated.

BATTERY CHARGER

The charging circuit consists of Q4149 and Q4139. The circuit regulates the average dc current charging the battery. Q4147 disables the charging circuit if the battery conditioner is activated. VR4282 limits output voltage if the battery is disconnected.

+2.5 V AND +5 V REGULATOR

U4165 provides a highly stable +2.5 volt reference for the +5 volt supply, and for the DVM and temperature converter circuits.

A divided-down sample of the +5 V output is picked off at the center arm of the +5 V adjustment (R4322) and is compared against the +2.5 V reference voltage at the input to U4156C. If the +5 V output attempts to go up, pin 8 of U4156C goes down, decreasing the current in Q4186 and holding the output at +5 volts. If the output attempts to go down, pin 8 of U4156C goes up, increasing the current in Q4186, and holding the output at +5 volts.

Diode CR4325 allows U4156C output to operate well below its positive supply limit.

Divider R4329/R4330 sets the +4 V reference for the Battery Status circuit.

POWER SUPPLY CONVERTER

Transistors Q4158, Q4159, and transformer T4300 make up an oscillator which produces a squarewave output to drive the various supply-voltage rectifiers. Squarewave frequency is in the range of 25-35 kHz and is dependent upon instrument load.

CONVERTER REGULATOR

Transistor Q4177 controls the base drive to Q4158 and Q4159, thus regulating the converter output voltage. Error amplifier U4156D drives the base of Q4177 through Q4176.

A change in the −12 V supply causes a change at pin 14 of U4156D which, in turn, adjusts the converter drive through Q4177.

CONVERTER START-UP

Q4175 turns on momentarily during monitor turn-on to ensure converter startup. When the power switch is pushed in, a positive voltage is coupled through C4334, turning on Q4175. This, in turn, turns on Q4177 to provide maximum base drive to Q4158 and Q4159. When the −12 V supply comes up, VR4332 clamps the base of Q4175 at −2 volts. This keeps Q4175 turned off, allowing U4156D to control Q4177. C4332 initiates the same start-up sequence when the line cord is plugged in with power applied.

OVERVOLTAGE SHUTDOWN

The overvoltage shutdown circuit (Fig. 3-20) is intended to protect the 413A in the event of a failure in the converter regulator. R4345 and R4347 form a voltage divider (with R4348 providing hysteresis) to compare the voltage between +7 V and −7 V and the on chip 2.6 V reference in U4126. If the voltage between +7 V and −7 V exceeds the threshold (14.8 to 17.4 V) the $V_{Sense\ 1}$ amplifier turns off the transistor at its output which adds positive feedback via R4348. $V_{Sense\ 2}$ amplifier output goes high, and the indicator output is pulled to −7 V. Q4189 is turned off, stopping base current flow in the converter, thus halting its operation.

BATTERY STATUS

The Battery Status circuit monitors the battery output voltage to control the BATTERY LED and the Low-Battery Shutdown circuit.

The BATTERY LED (DS3798) glows green at full intensity, when the battery voltage is 4.8 volts or more (or in process of being charged).

When the battery voltage drops to 4.7 volts, both the green and red LED sections glow at equal intensity (yellow). At this point there is 15-30 minutes of battery operating time remaining.

As the battery voltage drops to 4.6 volts, the LED glows red at full intensity. It is at this point that the Low-Battery Shutdown circuit is activated to shut down the monitor.

A summing node occurs at the junction of R4305 and R4306 such that when the battery voltage is 4.7 volts, pin 6 of U4156B is at 4 volts, the emitter of Q4184 is at 4 volts, and 10 milliamperes (20 mA required for full intensity) of current is flowing through Q4184 and the green side of DS3798. Also, pin 2 of U4156A is at 4 volts, the emitter of Q4185 is at 4 volts, and 5 milliamperes (10 mA required for full intensity) of current is flowing through Q4185 and the red side of DS3798. Thus, the green and red LEDs are on at one-half normal intensity

When the battery voltage goes up to 4.8 volts, the emitter of Q4184 goes down one volt to +3 volts due to the ×10 gain of inverting operational amplifier U4156B/Q4184. The emitter of Q4185 goes up one volt to +5 volts due to the ×1 gain of inverting operational amplifier U4156A/Q4185. This causes 20 milliamperes of current to flow through R4312, Q4185 and the green side of DS3798, and no current to flow through Q4185 and the red side of DS3798. Divider R4308-R4309 limits the current to 20 mA when the battery voltage exceeds 4.8 volts.

When the battery voltage goes down to 4.6 volts, the emitter of Q4184 goes to +5 volts and the emitter of Q4185 goes to +3 volts. This turns off the green side of DS3798 and turns on the red side of DS3798 to maximum intensity (10 mA through R4321 and Q4185).

When pin 7 of U4156B goes positive and the green LED goes out, pin 6 of U4155 is switched HI, CR4350 and Q4175 are turned on, Q4176 and Q4177 are off, removing the base drive from the converter transistors Q4158 and Q4159. This shuts down the power supply.

During ac-power operation, the voltage output from CR5424, across divider R4351/R4353, keeps Q4174 turned on and Q4175 turned off, preventing converter shutdown.

During operation between about 20% line voltage and minumum specified line voltage, K4260 is in the ac position. Instrument operating power is supplied from the battery via CR4260. Battery operating time under these conditions is limited because of the diode voltage drop in series with the battery.

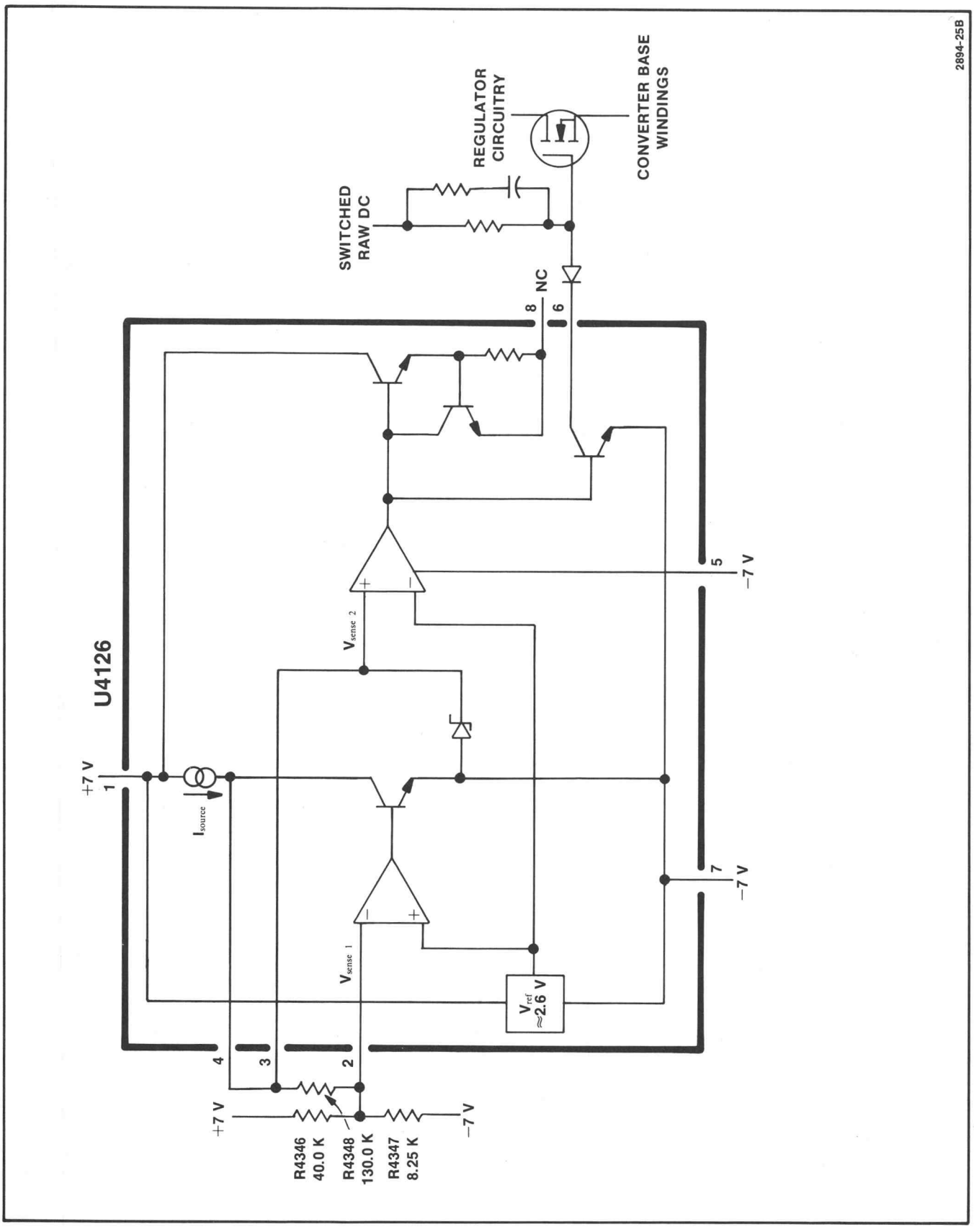


Fig. 3-20. Over-voltage shutdown block diagram.

BATTERY CONDITIONER BOARD

BATTERY CONDITIONER CIRCUIT FUNCTIONS

The battery conditioner reverses two conditions that occur over time to shorten 413A NiCd battery operating time.

Cell depression occurs with long periods of charging when cells are already fully charged. Charge unbalance occurs when cells within a pack have different capacity (amp-hours) and are charged and discharged many times. The cells with smaller capacity will always be fully charged more quickly. When a cell is full charged, additional energy fed into the cell is given off as heat. Adjacent cells are warmed and not able to take on charge efficiently. Over several charge-discharge cycles, the cells with more capacity will be charged to a lower level than the cells with small capacity.

Both cell depression and charge unbalance can be removed by discharging cells to about 0.6 volts. This can not be cone by leaving the 413A turned on in battery operation because the 413A will shut down at 4.6 volts of battery voltage (to prevent reverse charging any cell and prevent uncalibrated instrument operation). The battery conditioner consists of 2 discharge circuits (to prevent reverse charging) one for the upper pair and one for the lower pair of NiCd cells. Also included is a start circuit which verifies that the 413A is off, that the mains power is connected, that START has been pressed, and that at least one pair of cells still holds charge. The start circuit enables the two discharge circuits and disables the Main board battery charging circuit.

The discharge cycle takes up to 8 hours depending on cell charge. After the discharge cycle finishes, the start circuit is disabled and the 413A Main board battery charger is activated. Charging requires 16 hours, for a total conditioning cycle maximum time of 24 hours.

BATTERY CONDITIONER CIRCUIT OPERATION

The battery conditioning cycle is started by momentary closure of START switch (S22) when the monitor is connected to the ac power and the monitor power pushbutton is out (off).

When S22 is closed Q68 is turned on via R63 and CR67 causing Q58 to saturate. This turns on Q17 through R83 and CR35, and Q12 through R65 (paralleled by R64 and LED DS22). DS22 lights to indicate that the batteries are being discharged.

Q12, with Q13, and Q17, with Q16, act as constant current loads for 2 cells each. As Q12 turns on, its emitter goes up turning on Q13 through divider R24-R34 and limiting the base current to Q12 and thus the current through R51. In a similar manner Q16 limits the base current to Q17 and thus the current through R59.

Since S22 was only closed momentarily, Q68 must be held on by some other means. Therefore, when Q12 emitter goes up Q43 is turned on and Q68 is held on. Likewise when Q17 emitter goes up, Q46 is turned on. C42 is charged when S22 is closed to ensure that Q68 remains on until Q43 or Q46 turn on. Q50 is turned on through divider R60-R70 pulling down on pin 2 of P47 through R73 disabling the battery charge current.

Q12 and Q17 remain on until the monitor power pushbutton is set in (on), the ac power is disconnected or a cell pair voltage drops below about 0.6 volts.

When the monitor is turned on +12 volts is applied to pin 4 of P47 turning on CR53 and turning off CR67, Q68, and Q58. Thus Q12 and Q17 are turned off.

When ac power is disconnected from the monitor, the +8 V unreg at pin 3 of P47 drops to Zero turning off Q58, thus turning off Q12 and Q17.

When the voltage across the two-cell segment that is being discharged by Q12 drops to less that about 0.6 volts, Q43 is turned off. In a similar manner, when the voltage across the two cells that are being discharged by Q17 drops to less that 0.6 volts, Q46 is turned off. When both Q43 and Q46 are turned off, Q68 and Q58 are off, thus ending the battery discharge cycle.

When Q58 turns off, Q50 is turned off ungrounding pin 2 of P47 (Battery Charge Disable) allowing the battery charge cycle to begin.

CALIBRATION

INTRODUCTION

ECG LEAKAGE CHECK

ECG patient-circuit leakage must be checked following any repair or adjustment. Also, it is advisable to check leakage any time the monitor has been dropped or otherwise abused. A leakage check procedure is located at the end of the Check/Adjust Procedure and in Section 5, Maintenance.

ADJUSTMENT INTERVAL

Monitor performance should be checked and adjustments made at least every 1000 hours of operation, or 6 months if used infrequently. Partial or complete readjustment should be performed following specific repairs; see Section 5, Maintenance.

PARTIAL ADJUSTMENT

Partial adjustment is often desirable after replacing components or just to touch up the adjustment of a portion of the monitor between major performance checks.

Many adjustments can be made independently without affecting the adjustment of other portions of the monitor. However, if the +5 volt adjustment is changed, it will be necessary to check the performance of the entire monitor. Refer to Table 4-1 to determine which adjustments must be made when replacing circuit board assemblies and the cathode-ray tube (crt). Table 4-1 assumes replacement subassemblies to be fully functional and refers only to adjustable parameters. To verify non-adjustable parameters affected by the replaced subassembly, perform the appropriate CHECK steps in the Check/Adjust Procedure.

TEST EQUIPMENT REQUIRED

The test equipment and accessories listed in Table 4-2 are required to completly calibrate the 413A Monitor. The procedure is based on examples of test equipment given. When substituting other test equipment, you may have to change control settings or setups. The specifications given for the test equipment are the minimum necessary for accurate adjustment. All test equipment should be correctly calibrated and operating within specifications.

TABLE 4-1
Adjustments Needed After Assembly Replacement

THESE ASSEMBLIES ARE REPLACED / THESE ADJUSTMENTS MUST BE CHECKED OR ADJUSTED	A. POWER SUPPLY AND DISPLAY	A2. +5 V—R4166	A5. Trace Rotation—Yoke	A6. Spot Centering—Rings	A6. Focus—R440	A7. Horiz Position—R4127	A7. Horiz. Width—R4126	B. DIGITAL DISPLAY	B2. DVM Cal—R3900	C. TEMPERATURE	C2. Temp Span—R3692	C3. A °F Cal—R3622	C3. A °Cal—R3680	C5. B °F Cal—R3715	C5. B °C Cal—R3719	C8. ΔT Zero—R3732	D. PRESSURE/PULSE	D2. Gauge Factor—R3465	D3. Trace Zero—R3490	D3. Vertical Sensitivity—R4125	E. ECG	E2. Input Offset Null—R3064	E3. DC Level—R3004	E7. Gain—R3003	E10. Heart Rate—R3650	F. RESPIRATORY EFFORT	F3. Null—R3206	F4. Balance—R3203	F5. Gain—R3205	F8. Resp Rate—R3656	G. LEAKAGE CHECK
A30—ECG BOARD																						●	●	●	●		●	●	●		●
A31—RESPIRATION BOARD																											●	●	●	●	●
A32—PRESSURE/PULSE BOARD																															●
A33—CONDITIONER BOARD											●	●	●	●	●	●									●					●	●
A34—RATE ALARM CONTROL BOARD																															●
A35—READOUT SWITCH BOARD																															●
A36—DVM BOARD									●																						●
A37—DIGITAL DISPLAY BOARD																															●
A38—MAIN BOARD		●			●	●	●		●		●	●	●	●	●	●		●	●	●		●	●	●	●		●	●	●	●	●
A39—SWEEP SWITCH BOARD																															
A40—HIGH VOLTAGE BOARD			●	●	●	●	●												●	●											
V5440—CATHODE-RAY TUBE			●	●	●	●	●												●	●											

TABLE 4-2
Test Equipment

Description	Minimum Specifications	Examples of Applicable Test Equipment
1. Function Generator (2 required)	Output, 0.5 Hz to 10 Hz square-wave; Amplitude, 1 to 3 V (offset 0 to 1 V).	TEKTRONIX FG501 Function Generator.[a]
2. Test Oscilloscope	Bandwidth dc to ≥ 500 kHz; Minimum vertical deflection 1 mV/div; Sweep rates, 10 μs/div to 200 ms/div.	TEKTRONIX 7603 Oscilloscope System with 7A18 and 7A22[b] Amplifiers, 7B53A Time Base and two 10X probes.
3. Frequency Counter	Measures periods and Pulse length; Range, 800 μS: Frequency range, 1 Hz to 4 Hz; Accuracy, within 1%.	TEKTRONIX DC503 Universal Counter[a] with two 1X probes.
4. Digital Voltmeter (test DVM)	Accuracy, within 0.1% ±2 counts.	TEKTRONIX DM501 Digital Multimeter.[a]
5. Autotransformer	Output 98 to 265 Vac	General Radio Variac Autotransformer W10MT3W
6. True RMS Digital Voltmeter	Capable of measuring 10 mV with an accuracy of 2% or better.	TEKTRONIX DM501A Digital Multimeter.[a]
7. Power Supply	Voltage output, 10 V	TEKTRONIX PS501 Power Supply.
8. Pulse Sensor	Finger type	TEKTRONIX Part 015-0236-01
9. Pressure Transducer and Manometer.	Transducer Standardized to 50 μV/V/cmHg.	
10. ECG/Resp Test Fixture		Figure 4-1.
11. Temperature Sensor Simulator		Figure 4-2.
12. Optional Pressure Transducer Simulator[c]		Figure 4-3.
13. Pulse Test Fixture		Figure 4-4.
14. Precision Attenuator		Figure 4-5.
15. ECG Low-Pass Filter		Figure 4-6.
16. Resp Low-Pass Filter		Figure 4-7.
17. CMRR Test Fixture		Figure 4-8.
18. Stereo Phone Plug		Switchcraft #297.

[a] Requires TM500 Power Module.

[b] 7A22 needed only when Optional Pressure Transducer Simulator is used.

[c] The Optional Pressure Transducer Simulator may be used instead of the Pressure Transducer and Manometer. The Calibration Procedure allows for either setup.

TABLE 4-2 (CONT)
Test Equipment

Description	Minimum Specifications	Examples of Applicable Test Equipment
19. Test Capacitor (0.47 μF)		
20. BNC to Dual Binding Post Adapter		TEKTRONIX Part 103-0035-00.
21. Patient Cable		TEKTRONIX Part 012-0739-00
22. Safety Analyzer		Neurodyne - Dampsey Safety Analyzer, Model #431

SPECIAL TEST ACCESSORIES

The special test accessories (Fig. 4-1 through 4-8) required for adjustment can be constructed using common electronic components. Be sure to use components with at least the accuracy specified.

ECG/Respiration Test Fixture

Figure 4-1 shows a circuit which produces a simulated QRS pulse and an impedance change that simulates respiration. This circuit is necessary to calibrate the 413A.

Figure 4-1 shows a one-to-one layout of the circuit which can be used to make an etched circuit board. To make connection to the 413A, cut the snap connectors off of 3 patient leads and solder the leads to the LL, LA, and RA connections of the test circuit. These leads may then be directly connected to the branch block of an ECG patient cable.

Optional Pressure Transducer Simulator

Figure 4-3 shows a circuit which simulates the output of a pressure transducer. You may use this circuit in place of a manometer and pressure transducer when calibrating the 413A pressure channel.

Figure 4-3 also shows a one-to-one layout of the circuit which can be used to make an etched circuit board. If a defective pressure transducer is available, the cable can be cut and used to make connection between the 413A and the test circuit in place of the the cable and connector listed.

Zero Adjustment. To simulate a pressure transducer with no offset, you must adjust the simulator Offset Zero (R70). To use the monitor excitation to perform this adjustment, the monitor ZERO adjustment must be disconnected. When driven by the monitor excitation, the scale factor is 80 μV per simulated mmHg. The resulting range of adjustment for R70 is about ±12 mV or ±150 mmHg.

a. Connect simulator to monitor PRESSURE TRANSDUCER INPUT.

b. Disconnect P4194 (pressure ZERO control connections) from 413A Main board.

c. Set 413A:

MONITOR ..... In (on)
PRESSURE 125 ..... In

d. Connect 1× probes to test oscilloscope differential plugin vertical input. Connect probe tips to points A and C on transducer simulator.

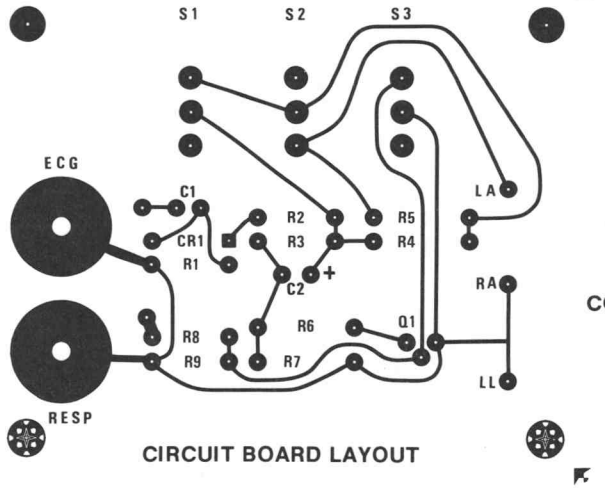
e. Set test oscilloscope:

Volts/Div ..... 500 mV
HF -3 dB ..... 3 kHz
LF -3 dB ..... DC
Time/Div ..... 2 ms

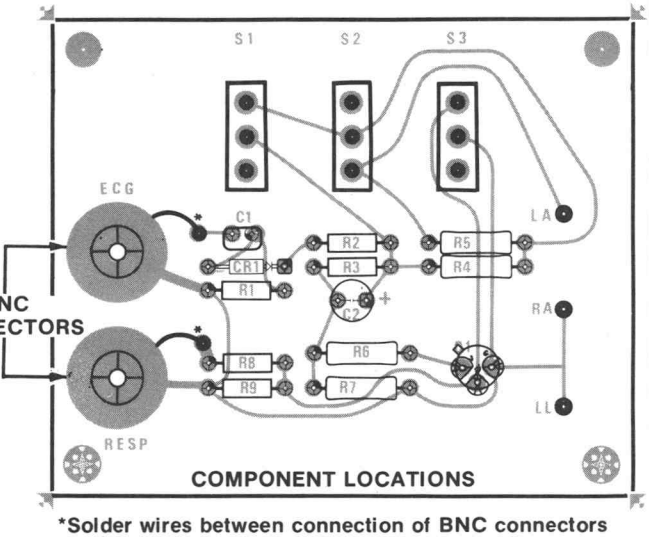
f. Trigger oscilloscope sweep on waveform spikes.

g. Adjust Zero (R70 on transducer simulator) for less than 100 μV between flat portions of the waveform (see Fig. 4-9). Readjust test oscilloscope Volts/Div as needed.

h. Reconnect P4194 on 413A Main board.

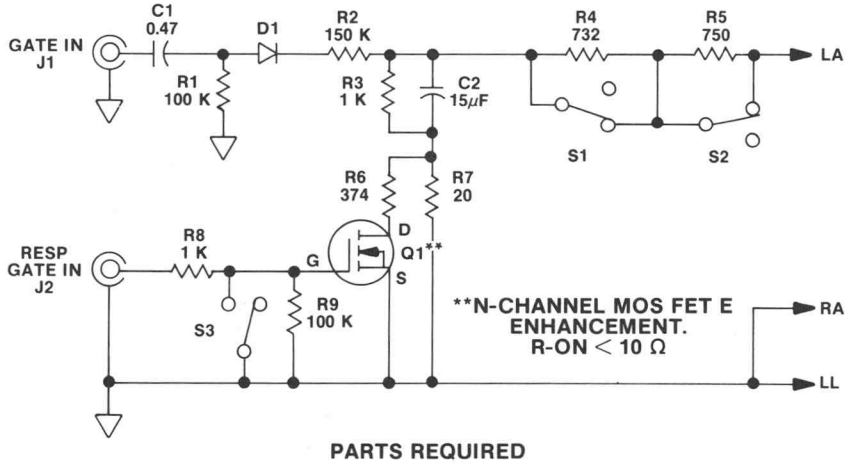


CIRCUIT BOARD LAYOUT



COMPONENT LOCATIONS

*Solder wires between connection of BNC connectors and indicated hole in circuit board.

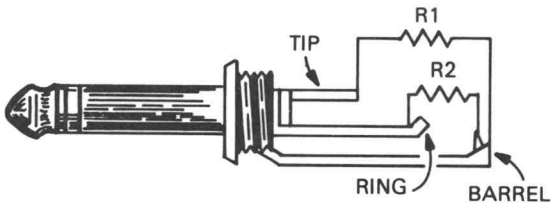


PARTS REQUIRED

CKT NO.	TEKTRONIX PART NO.	NAME & DESCRIPTION
C1	283-0203-00	CAP.,FXD,CER D1: 0.47 μF, 20%, 50 V
C2	290-0527-00	CAP.,FXD,ELCTLT: 15 μF, 20%, 20 V 20 FL
D1	152-0141-02	SEMICOND DVC, DI: SW, SI, 30 V, 150 mA
J1, J2	131-0955-00	CONN, RCPT, ELEC: BNC FEMALE
Q1	151-1121-00	TRANSISTOR: FE, N-CHANNEL
R1, R9	315-0104-00	RES., FXD, CMPSN: 100 kΩ, 5%, 0.25 W
R2	315-0154-00	RES., FXD, CMPSN: 150 kΩ, 5%, 0.25 W
R3, R8	315-0102-00	RES., FXD, CMPSN: 1 kΩ, 5%, 0.25W
R4	321-0180-00	RES., FXD, FILM: 732 Ω, 1%, 0.125 W
R5	321-0181-00	RES., FXD, FILM: 750 Ω, 1%, 0.125 W
R6	321-0152-00	RES., FXD, FILM: 374 Ω, 1%, 0.125 W
R7	321-0030-00	RES., FXD, FILM: 20.0 Ω, 1%, 0.125 W
S1,S2,S3	260-1869-00	SWITCH TOGGLE: SPDT, 0.4 A, 20 V

2894-32

Fig. 4-1. ECG/Resp test fixture.



°F	°C	R1(Ω)	TEKTRONIX Part Number	R2(Ω)	TEKTRONIX Part Number
23	−5	25.40 K	321-1690-07	122.1 K	321-1692-07
41	5	15.24 K	321-1688-07	74.44 K	321-1691-07
77	25	6000	321-1696-07	30.00 K	321-0685-07
113	45	2620	321-1694-07	13.28 K	321-1687-07
98.6	37	3610	NONE	18.21 K	NONE

NOTES:

1. RESISTORS USED FOR THESE PLUGS SHOULD HAVE VALUES WITHIN 0.1% AND HAVE LOW TEMPERATURE COEFFICIENTS.

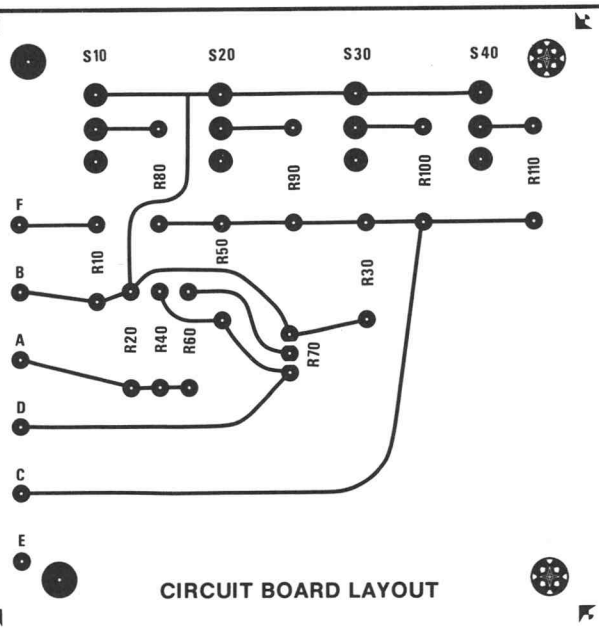
2. ANY SERIES OR PARALLEL COMBINATION OF QUALITY RESISTORS CAN BE USED TO PRODUCE VALUES OF R1 AND R2.

3. 98.6°F/37°C IS NOT NEEDED FOR ADJUSTMENT PROCEDURE; IT IS GIVEN FOR REFERENCE ONLY.

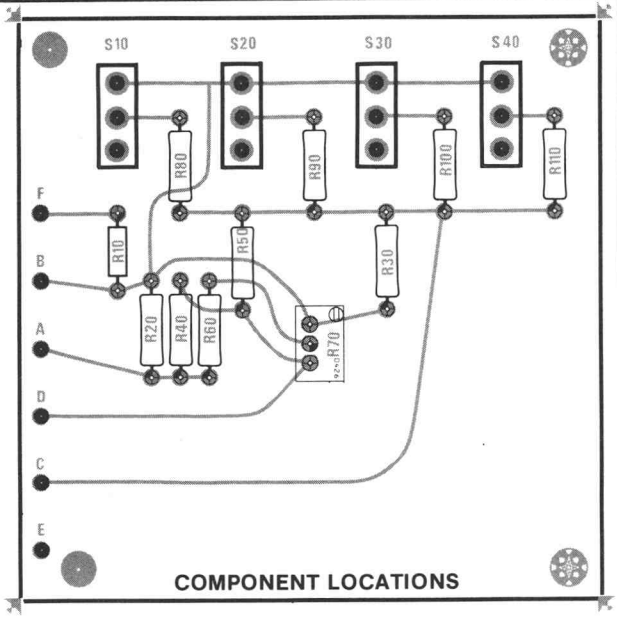
4. 23°F/−5°C RANGE CHECKED IN 400 RECORDER ONLY.

2042-101

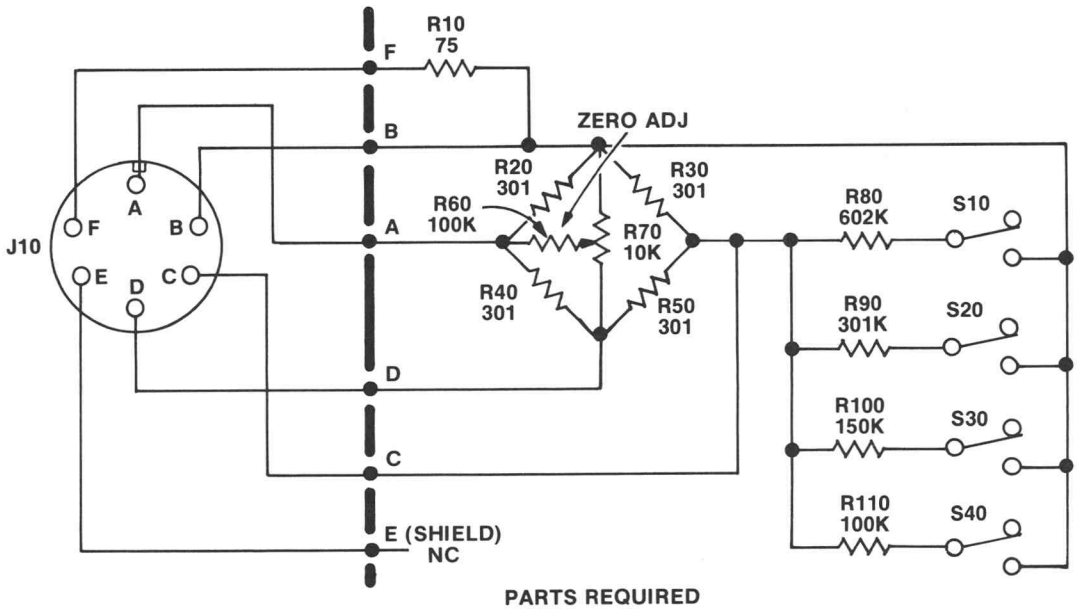
Fig. 4-2. Temperature sensor simulators.



CIRCUIT BOARD LAYOUT



COMPONENT LOCATIONS



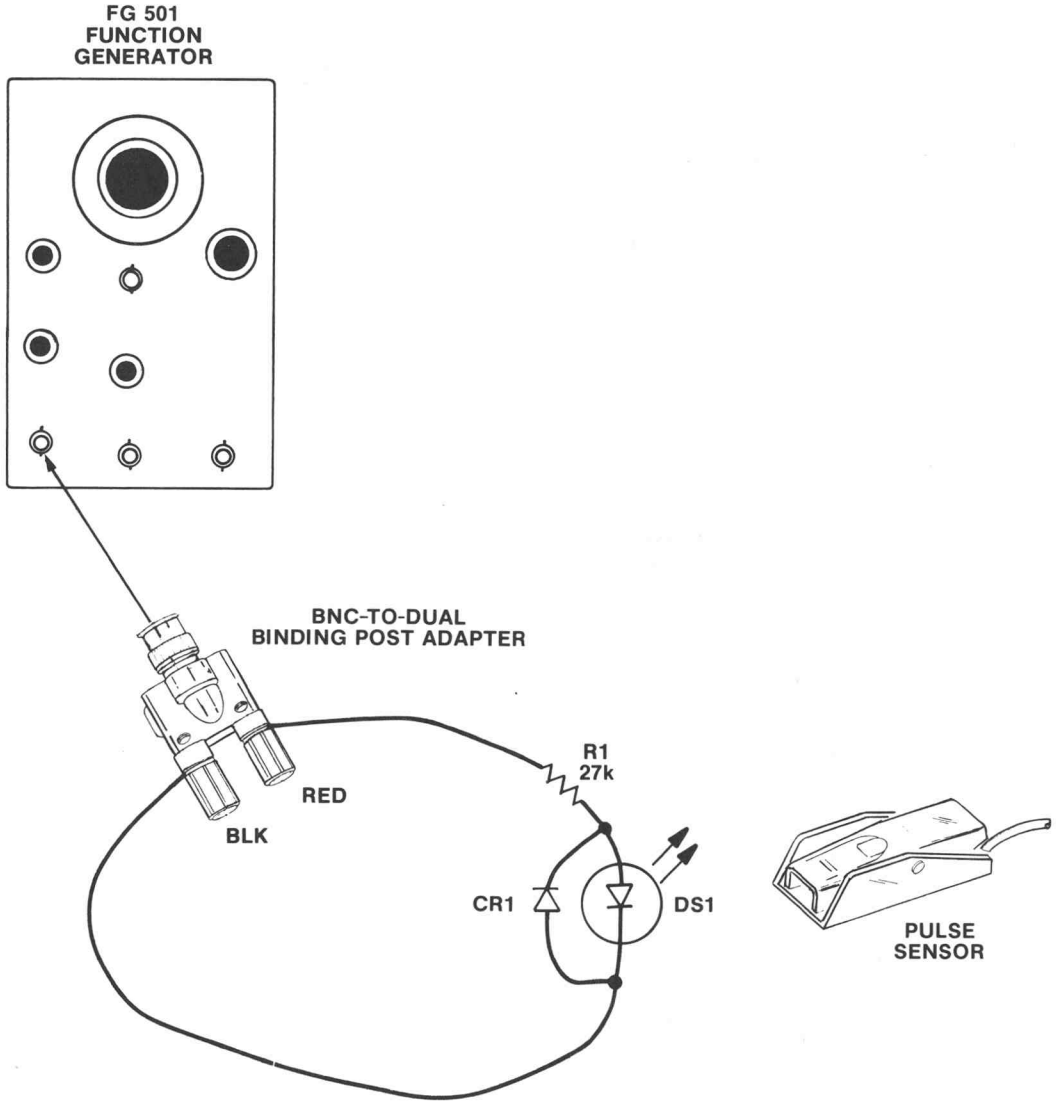
PARTS REQUIRED

CKT NO.	TEKTRONIX PART NO.	NAME & DESCRIPTION
J10	131-1774-00	CONN, PLUG, ELEC: MS-A SERIES, 6 CONT MALE
R10	317-0750-00	RES., FXD, CMPSN: 75 Ω, 5%, 0.125 W
R20, R30 R40, R50	321-0143-07	RES., FXD, FILM: 301 Ω, 0.1%, 0.125 W
R60, R110	321-0385-07	RES., FXD, FILM: 100 kΩ, 0.1%, 0.125 W
R70	311-1860-00	RES., VAR, NONW W:TRMR, 10 kΩ, 0.5 W
R80	321-0976-04	RES., FXD, FILM: 602 kΩ, 0.1%, 0.125 W
R90	321-0431-04	RES., FXD, FILM: 301 kΩ, 0.1%, 0.125 W
R100	321-0402-09	RES., FXD, FILM: 150 kΩ, 1%, 0.125 W

2894-33

Fig. 4-3. Optional pressure transducer simulator.

@

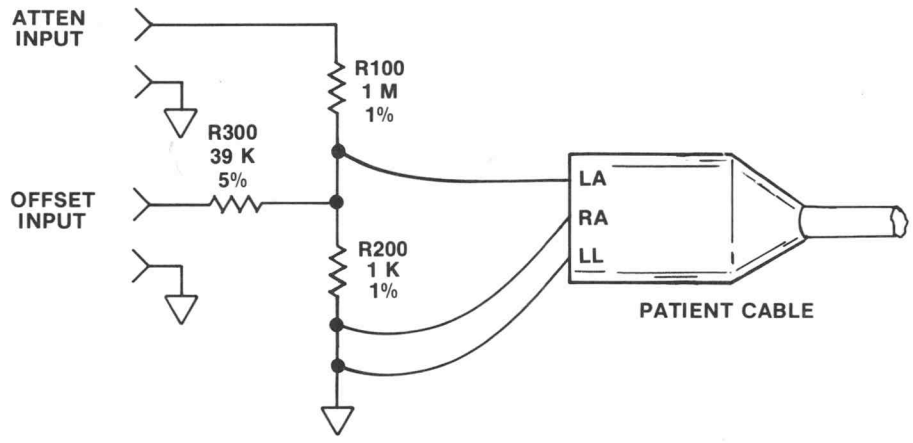


CKT NO.	TEKTRONIX PART NO.	NAME & DESCRIPTION
CR1	152-0141-02	SEMICOND DVC, DI: SW SI 30 V 150 mA
DS1	150-1001-02	LT EMITTING DIO: RED, 660 NM, 50 mA MAX
R1	315-0273-00	RES., FXD, CMPSN. 27 kΩ, 5%, 0.25 W

2894-34

Fig. 4-4. Pulse test fixture.

PRECISION ATTENUATOR



CKT NO.	TEKTRONIX PART NO.	NAME & DESCRIPTION
R100	321-0481-00	RES., FXD, FILM: 1 MΩ, 1%, 0.125 W
R200	321-0193-00	RES., FXD, FILM: 1 kΩ, 1%, 0.125 W
R300	315-0393-00	RES., FXD, CMPSN: 39 kΩ, 5%, 0.25 W

2894-35

Fig. 4-5. Precision test fixture.

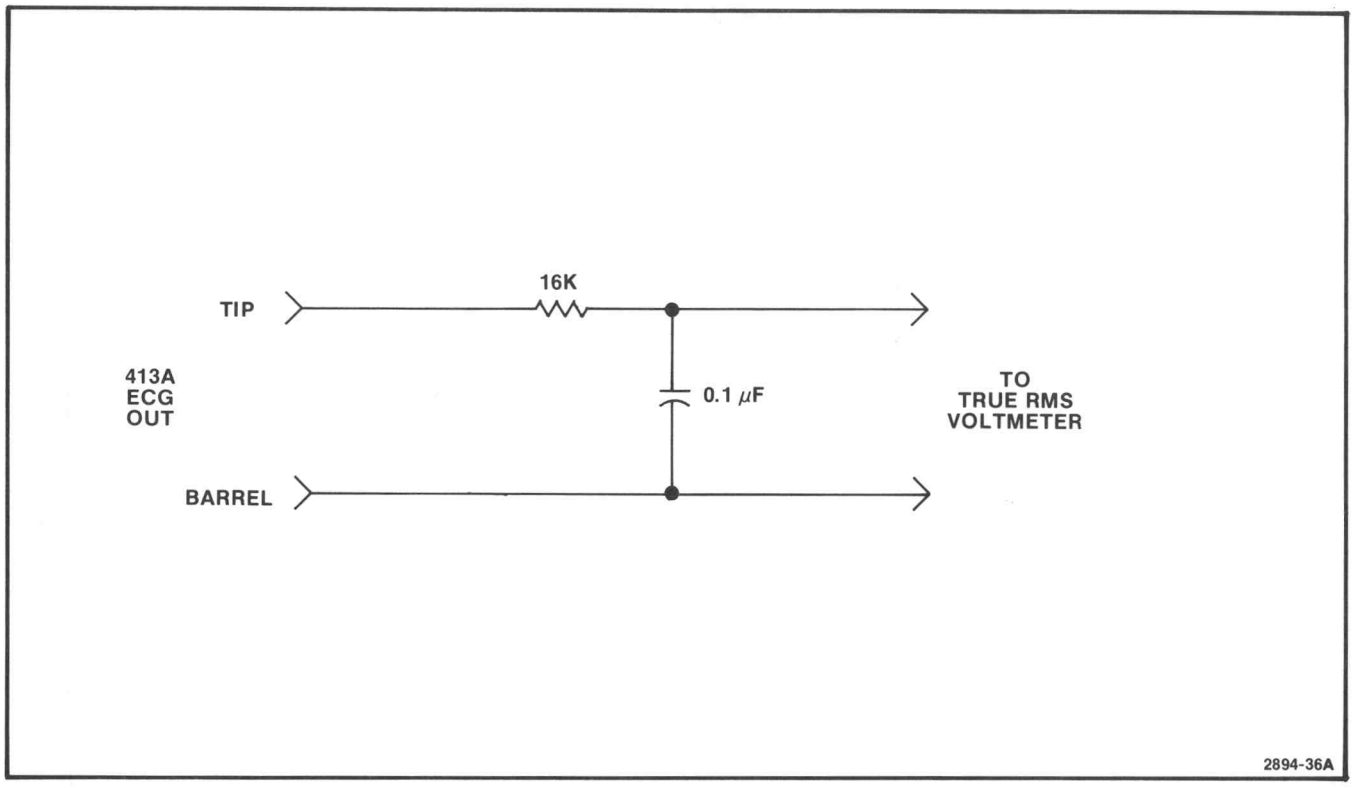


Fig. 4-6. ECG low-pass filter.

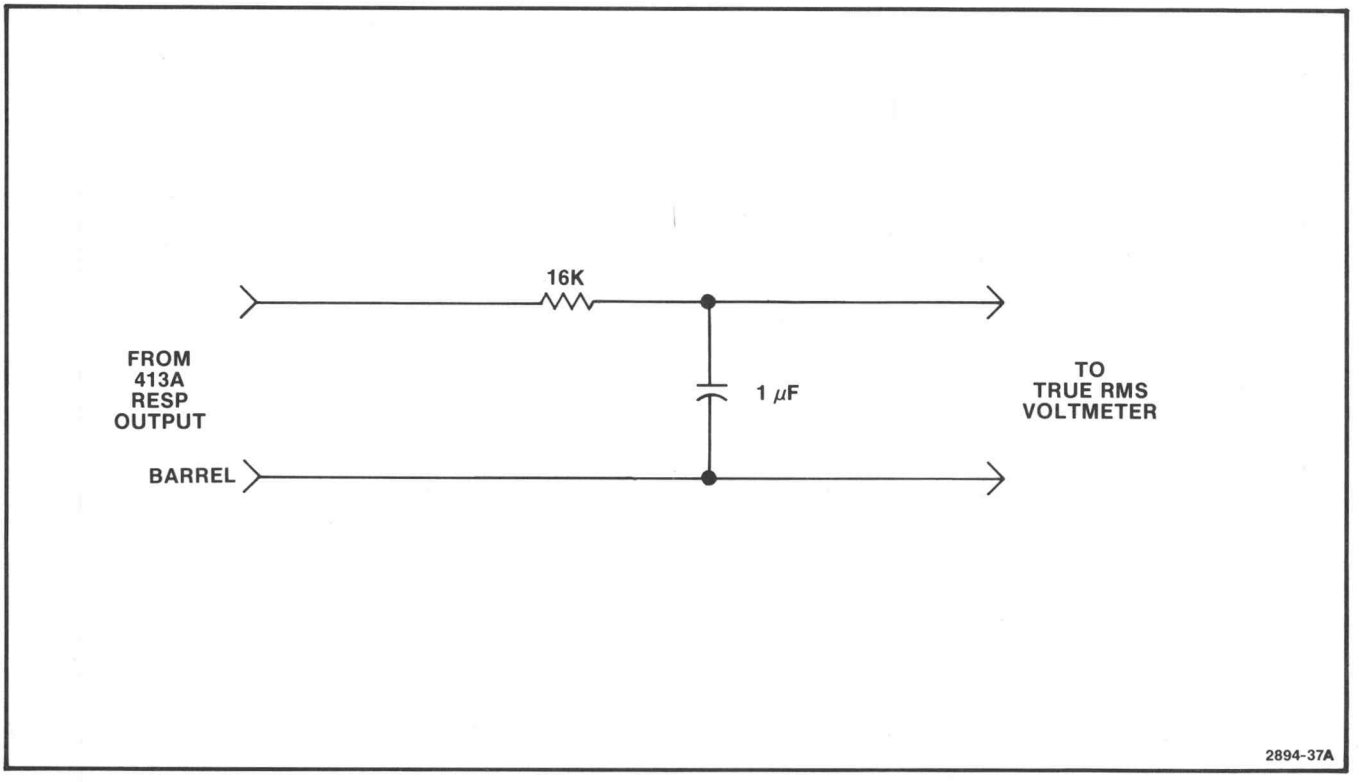


Fig. 4-7. Resp low-pass filter.

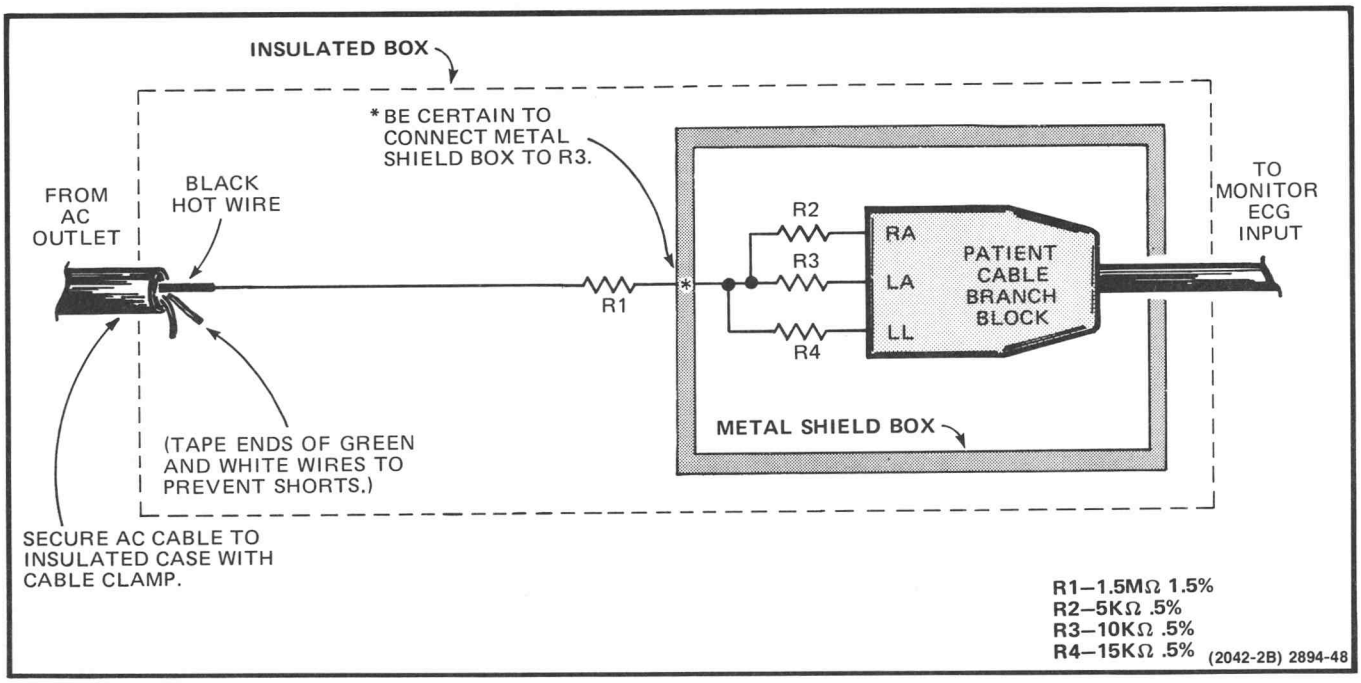


Fig. 4-8. CMRR test fixture.

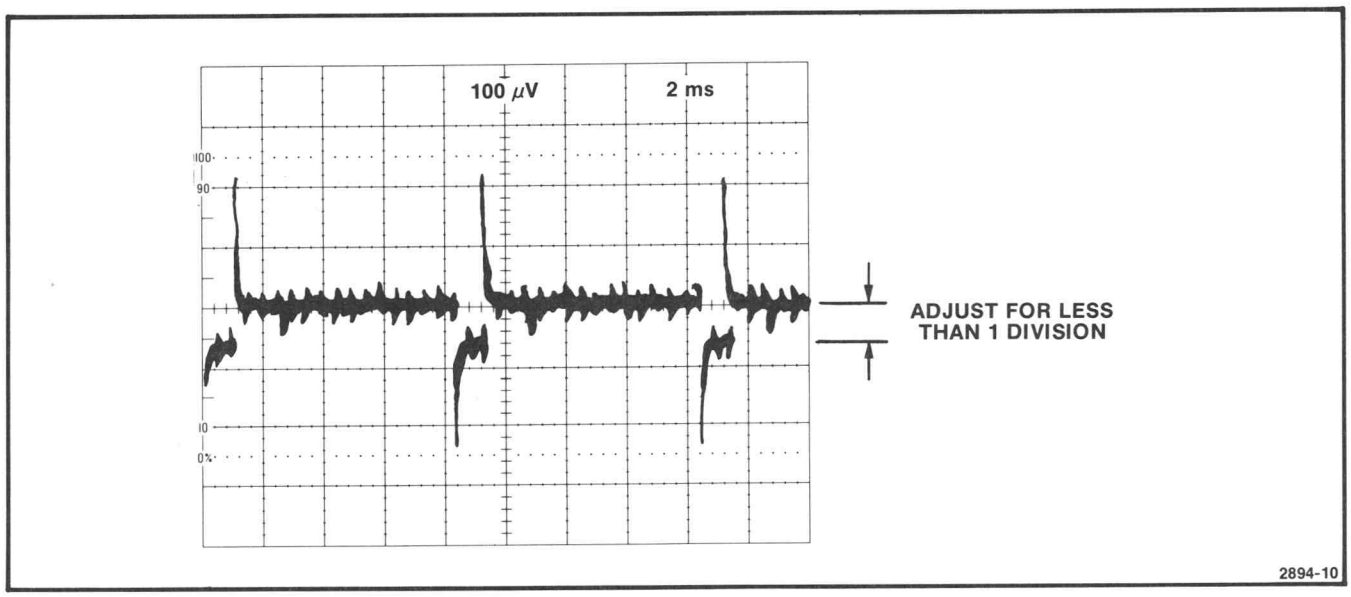


Fig. 4-9. Optional pressure transducer simulator zero adjustment waveform.

CHECK/ADJUST PROCEDURE

PURPOSE

The purpose of this procedure is to permit the complete calibration of an operating monitor. The procedure is divided by major functions making it easier to adjust individual portions of the monitor.

OPERATING TEMPERATURE

The monitor should be adjusted at an ambient temperature of +20° to +30° C for best overall accuracy.

PRELIMINARY PROCEDURE

WARNING

High voltage and high battery current capabilities exist inside the monitor. Voltages of over 15 volts are low-current sources and are not considered dangerous, but could produce an electrical shock. All line-voltage connections are covered and located on the rear panel.

1. Check that the instrument has been set for the proper power source and also that the appropriate power cord and plug has been attached. Refer to Section 2, Operating Instructions.

2. Remove top and bottom covers to gain access to internal adjustments. Remove the four screws from each side. Pull the bottom cover straight away from the monitor. Lift the left side of top cover to permit the right side to clear the ECG/RESP LEAD TEST terminals.

3. Connect the monitor power cord to the mains power source.

4. Allow monitor to warm up for about 20 minutes before making adjustments.

5. Check operation of all modes and correct any defects before making adjusments to the monitor.

A. POWER SUPPLY AND DISPLAY

Equipment Required

1. Autotransformer
2. Digital Voltmeter (test dvm)
3. Function Generator
4. Frequency Counter
5. ECG/Resp Test Fixture (Fig. 4-1)
6. Patient Cable

A1. POWER SUPPLY AND DISPLAY PRELIMINARY SETUP

a. SET 413A controls:

MONITOR ..... In (on)
PRESSURE/PULSE ALARM ..... Out (off)
PRESSURE/PULSE TRACE OFF ..... In (off)
RESPIRATORY EFFORT SIZE ..... CCW (off)
RESP TRACE OFF ..... Out (on)
ECG CHANNEL OFF ..... In (off)
LOW HEART RATE LIMIT ..... OFF (ccw)
LOW RESP RATE LIMIT ..... OFF (ccw)

Set other controls as desired.

b. See TESTPOINT AND ADJUSTMENT LOCATIONS pullout page in Section 8, Diagrams and Circuit Board Illustrations.

A2. ADJUST +5 VOLTS (R4166)

a. Connect Test dvm – lead to TP4384 (ground testpoint at front of Main board). Connect test dvm + lead to TP4186 (+5V).

b. **CHECK**—Test dvm reading is 4.975 to 5.025 V.

NOTE

Do not readjust +5 V supply unless error exceeds 25 mV or you are going to perform complete Adjustment Procedure.

c. **ADJUST**—+5 V (R4166, Main board) for a test dvm reading of 5.000 V (4.995 to 5.005 V).

A3. CHECK POWER SUPPLY VOLTAGES

a. **CHECK**—Power Supply voltage. They should be within tolerances given in Table 4-3. (Power Supply test points are located along front edge of main board.)

b. **INTERACTION**—If power supplies are not within tolerances given in Table 4-3, repeat step A2.

TABLE 4-3
Power Supply Limits

Supply	Limits
+12	+11.5 to +12.5
+7	+6.8 to +7.2
-7	-6.8 to -7.2
-12	-11.5 to -12.5

A4. CHECK POWER LINE VOLTAGE RANGE

a. Disconnect 413A battery connector plug (P4110, near rear of Main board). This is necessary because of circuitry which prevents instrument shutdown on short duration drops in line voltage

b. Connect 413A power cord through autotransformer to mains power source.

c. **CHECK**—413A functions and -12 V supply remains in regulation while varying autotransformer from 98 to 132 Vac.

d. Reconnect battery connector (P4110) to 413A Main board.

e. **CHECK**—413A does not turn off as autotransformer voltage is reduced from 120 Vac to 0 Vac and back to 120 Vac. 413A may go out of regulation below 98 Vac. This check tests circuitry which draws power from battery to prevent instrument shutdown during time between loss of mains power and startup of auxiliary generator.

f. Disconnect 413A power cord from autotransformer and reconnect directly to mains power.

A5. ADJUST TRACE ROTATION (YOKE)

WARNING

To avoid electrical shock, use care when making yoke adjustments. There are dangerous voltages close by.

a. Set 413A ECG CHANNEL OFF button in.

b. **CHECK**—Trace is parallel with graticule lines. If parallel, skip remainder of this step.

c. Loosen yoke clamps (Fig. 4-10).

d. While keeping yoke as far forward as possible, rotate yoke for best non-tilted trace.

e. Tighten yoke clamps.

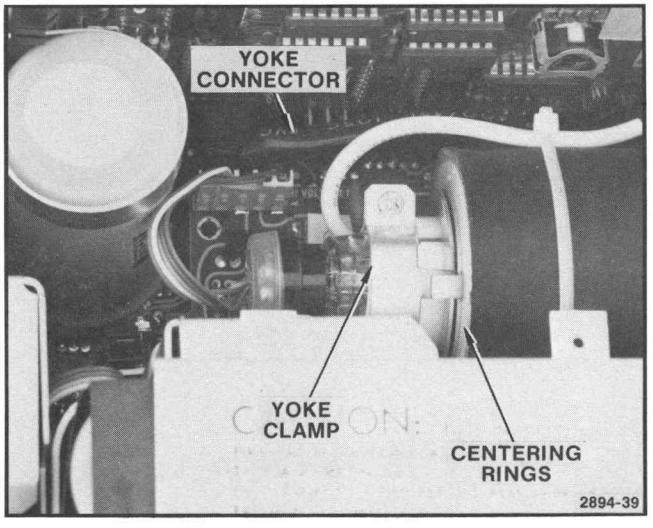


Fig. 4-10. Spot-centering and focus adjustments.

A6. ADJUST SPOT CENTERING AND FOCUS (RINGS AND R4440)

a. Set 413A MONITOR button out (OFF).

b. Disconnect yoke cable by disconnecting P4144 (Fig. 4-10).

c. Set 413A MONITOR button in (ON).

d. **ADJUST**—Centering rings for a centered spot on crt. See Figure 4-10.

e. **ADJUST**—Focus (R4440, HV board) for smallest possible round dot.

f. Set 413A MONITOR button out (OFF) reconnect yoke cable, and set 413A MONITOR button in (ON).

A7. ADJUST HORIZONTAL POSITION (R4127) AND HORIZONTAL WIDTH (R4126)

NOTE

Horizontal Width and Position adjustments interact as follows:

1. Width stretches trace outward in both directions from about 40 bpm graticule mark.

2. Position moves entire trace from side to side without significantly affecting Width, as long as adjustment is fairly small.

a. Connect 413A patient cable, ECG/Resp test fixture, frequency counter, and function generator as shown in Figure 4-11.

b. Set function generator

Function ..... (squarewave)
DC Offset 0
Frequency Multiplier 1
Frequency Dial 4
Cal ..... CW

c. Set frequency counter

Function ..... PERIOD B
Clock Rate ..... CCW (1 μsecond)
CH B Ac Coupl ..... In (AC)

d. Set function generator for a frequency counter reading of 250 ms (245 to 255 ms). This produces a simulated heart rate of 240 BPM (4 Hz).

e. Set 413A:

ECG I
SWEEP SPEED 100
ECG SIZE ..... Midrange

f. Set function generator amplitude for a 413A display amplitude of 2 divisions.

g. Set 413A ECG SIZE so that top of 413A display touches BPM markings at top edge of crt graticule.

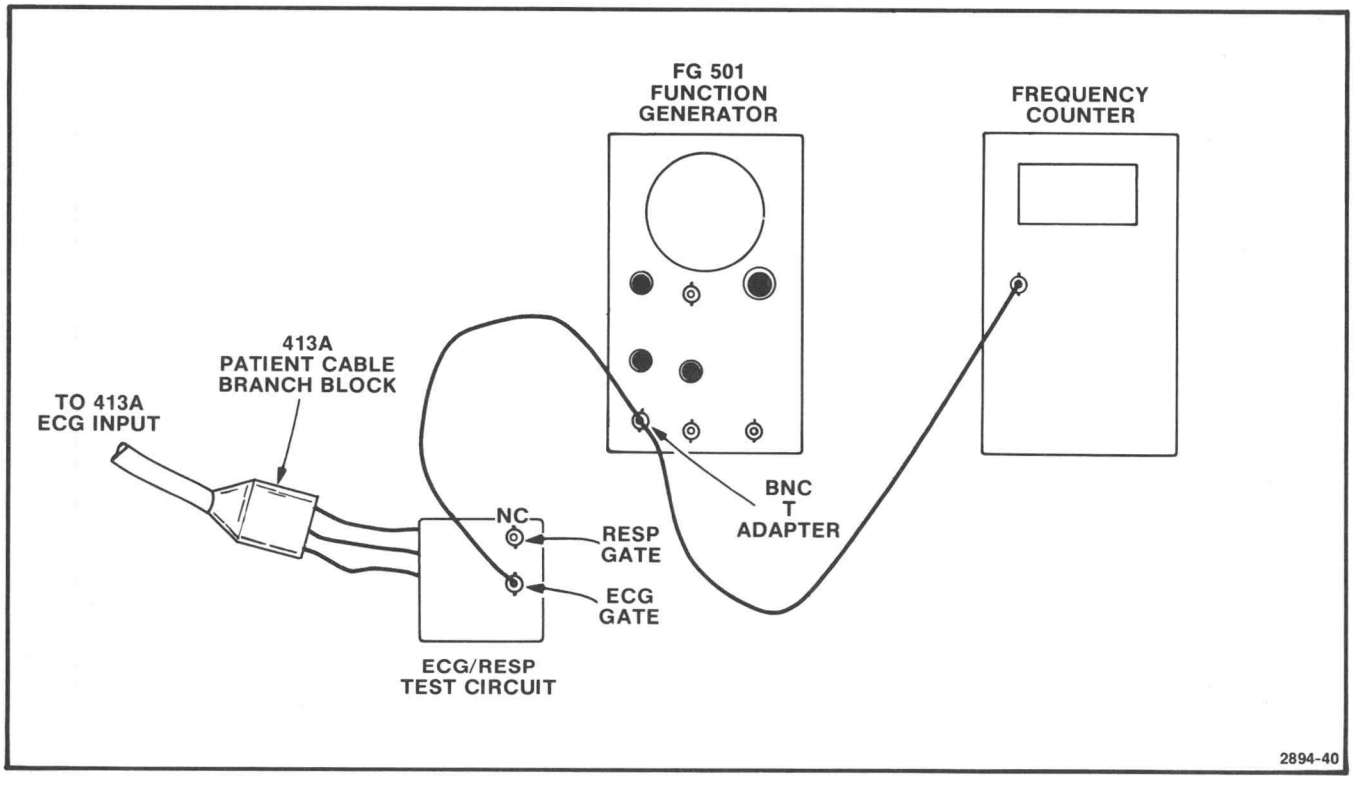


Fig. 4-11. Horizontal Position and Width adjustment setup.

h. **ADJUST**—Horizontal Position (R4127, Main board) to set rising edge of fourth pulse to 40 BPM mark (see Fig. 4-12).

i. **ADJUST**—Horizontal Width (R4125, Main board) to move rising edge of second pulse to 120 BPM mark (see Fig. 4-12).

j. Repeat parts h and i as needed due to interaction.

k. **CHECK**—413A display is within limits given in Table 4-4.

l. Set 413A SWEEP SPEED mm/SEC 100 in.

m. Watch QRS light. At moment QRS light flashes, set 413A ECG CHANNEL OFF button in and start timer. The display will finish sweeping, then stop at the left edge of the crt. When the display begins sweeping again, stop the timer.

n. **CHECK**—Measured time interval is 3 to 5 seconds.

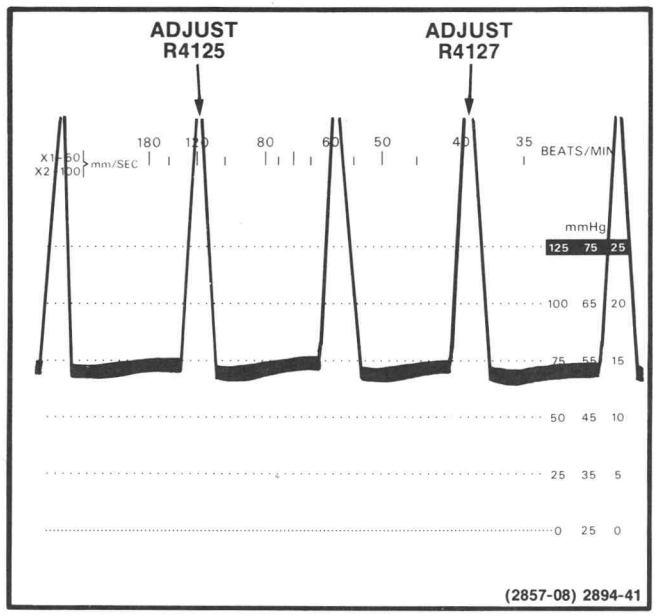


Fig. 4-12. Horizontal Position and Width adjustments.

TABLE 4-4
413A SWEEP SPEED Accuracy

FREQ. GENERATOR		413A SWEEP SPEED	LIMITS
FREQ	PERIOD		
2 Hz	500 ms	100 mm	Second pulse within 2.5 mm of 60 BPM mark
1 Hz	1 sec	50 mm	Second pulse within 2.5 mm of 60 BPM mark.
		25 mm[a]	5 cm within 2.5 mm between pulses
0.5 Hz	2 sec	12.5 mm[a]	2.5 cm within 1.25 mm between pulses

[a] Sweep is not triggered. Measurements must be made by measuring between successive pulses with a ruler.

B. DIGITAL DISPLAY

Equipment Required

1. Digital Voltmeter (test dvm)
2. 77° F and 113° F Temperature Sensor Simulators (See Fig 4-2)
3. Frequency Counter (with 1× probe).

B1. DIGITAL DISPLAY PRELIMINARY SETUP

a. Set 413A controls:

MONITOR ..... In (on)
PRESSURE/PULSE ALARM ..... Out (off)
PRESSURE/PULSE TRACE OFF ..... In (off)
RESP TRACE OFF ..... Out (on)
RESP SIZE ..... CCW (off)
ECG CHANNEL OFF ..... In (off)
LOW HEART RATE LIMIT ..... CCW (off)
LOW REST RATE LIMIT ..... CCW (off)

Set other controls as desired.

b. See TESTPOINT AND ADJUSTMENT LOCATIONS pullout page in Section 8, Diagrams and Circuit Board Illustrations.

NOTE

To ensure maximum accuracy, signal conditioners and dvm must be adjusted independently. Neither dvm nor conditioners should be compromised. This is especially true if peripheral devices (such as 400 or 401) are monitoring conditioner outputs.

B2. ADJUST DVM CAL

a. Insert 113° F temperature sensor simulator in 413A TEMP A input.

b. Set 413A:

TEMPERATURE A ..... IN
°C/°F ..... °F

c. Connect test dvm (+) lead to P2400-9 on Conditioner board. Connect test dvm – lead to P2400-12 on Conditioner board.

NOTE

The following adjustment calibrates dvm to correctly display voltage on outputs of signal conditioners (in this case A Temperature converter). A later adjustment calibrates output of temperature converter.

d. **ADJUST**—Dvm Cal (R3900, DVM board) so that 413A digital readout and test dvm correspond.

Example: If test dvm reads 1.1349, adjust R3900 so that 413A digital readout is 113.5.

B3. CHECK DVM UPDATE TIME

a. Connect 1× probe between frequency counter CH B input and P3600-27 on conditioner board.

b. Set frequency counter:

FUNCTION ..... PERIOD B
B ATTEN ..... ×1
CLOCK RATE ..... 1 μsec (CCW)
AC COUPL ..... OUT (DC)

c. **CHECK**—Period indicated by frequency counter is 750 ms to 1250 ms.

d. Disconnect frequency counter.

C. TEMPERATURE

Equipment Required

1. Digital Voltmeter (test dvm)
2. 77° F and 113° F Temperature Sensor Simulators (See Fig.4-2).

C1. TEMPERATURE PRELIMINARY SETUP

a. Set 413A controls:

MONITOR ..... In (on)
PRESSURE/PULSE ALARM ..... Out (off)
PRESSURE/PULSE TRACE OFF ..... In (off)
RESP TRACE OFF ..... Out (on)
RESP SIZE ..... CCW (off)
ECG CHANNEL OFF ..... In (off)
LOW HEART RATE LIMIT ..... CCW (off)
LOW RESP RATE LIMIT ..... CCW (off)

b. See TESTPOINT AND ADJUSTMENT LOCATIONS pullout page in Section 8, Diagrams and Circuit Board Illustrations.

C2. ADJUST TEMP SPAN (R3692)

a. Connect test dvm + lead to +1.759 V test point on conditioner board.

b. Connect test dvm - lead to GND test point on Conditioner board.

c. **ADJUST**—Temp Span (R3692, Conditioner board) for a test dvm reading of 1.7590 V.

C3. ADJUST A °F CAL (R3622) AND A °C CAL (R3680)

a. Move test dvm + lead to P2400-9.

b. Inset 77° F/25° C temperature sensor simulator into TEMP A input on 413A rear panel.

c. Set 413A rear-panel °F/°C switch to °F.

d. **ADJUST**—A °F Cal (R3622, Conditioner board) for a test dvm reading of 0.770 V.

e. Set 413A TEMPERATURE A button in.

f. **CHECK**—413A digital display is 76.5 to 77.5 and °F indicator is on.

g. Set 413A °F/°C switch to °C.

h. **ADJUST**—A °C Cal (R3680, Conditioner board) for a test dvm reading of 0.250 V.

i. **CHECK**—413A digital display is 24.7 to 25.3 and °C indicator is on.

j. Remove 77° F/25° C temperature sensor simulator and insert 113° F/45° F simulator.

k. **CHECK**—413A digital display is 44.8 to 45.3.

l. Set 413A °F/°C switch to °F.

m. **CHECK**—413A digital display is 112.5 to 113.5.

n. Remove 113° F/45° C simulator and insert 41° F/5° C simulator.

o. **CHECK**—413A digital display reads 40.5 to 41.5.

p. Set 413A °F/°C switch to °C.

q. **CHECK**—413A digital display is 4.7 to 5.3.

C4. CHECK TEMP A NO PROBE AND PROBE FAULT SENSING.

a. **CHECK**—413A digital display blanks when one or both resistors in temperature sensor Simulator are shorted.

b. **CHECK**—Digital display is visible when short is removed.

c. **CHECK**—Digital display blanks when temperature probe simulator is removed.

C5. ADJUST B °F CAL (R3715) AND B °C CAL (R3719)

a. Move test dvm + lead to P2400-16.

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b. Insert 77° F/25° C temperature sensor simulator into TEMP B input on 413A rear panel.

c. Set 413A rear-panel °F/°C switch to °F.

d. **ADJUST**—B °F Cal (R3715, Conditioner board) for a test dvm reading of 0.770 V.

e. Set 413A TEMPERATURE B button in.

f. **CHECK**—413A digital display is 76.5 to 77.5 and °F indicator is on.

g. Set 413A °F/°C switch to °C.

h. **ADJUST**—B °C Cal (R3719, Conditioner board) for a test dvm reading of 0.0250 V.

i. **CHECK**—413A digital display is 24.7 to 25.3 and °C indicator is on.

j. Remove 77° F/25° C temperature sensor simulator and insert 113° F/45° F simulator.

k. **CHECK**—413A digital display is 44.8 to 45.3.

l. Set 413A °F/°C switch to °F.

m. **CHECK**—413A digital display is 112.5 to 113.5.

n. Remove 113° F/45° C simulator and insert 41° F/5° C simulator.

o. **CHECK**—413A digital display reads 40.5 to 41.5.

p. Set 413A °F/°C switch to °C.

q. **CHECK**—413A digital display is 4.7 to 5.3.

C6. CHECK TEMP B NO PROBE AND PROBE FAULT SENSING

a. **CHECK**—413A digital display blanks when one (or both) resistors in temperature sensor simulator are shorted.

b. **CHECK**—Digital display is visible when short is removed.

c. **CHECK**—Digital display blanks when temperature probe simulator is removed.

C7.CHECK TEMP TEST

a. **CHECK**—413A digital display is within limits given in Table 4-5.

TABLE 4-5
Temperature Test Accuracy

TEMP TEST BUTTON	°F/°C	TEMPERATURE READOUT SELECTION	DIGITAL READOUT LIMITS
PUSHED AND HELD	°F	A / B	101.0 to 101.6
	°C	B / A	38.3 to 38.7

C8. ADJUST △T ZERO (R3732)

a. Set 413A:

TEMPERATURE A and B ..... Both In
°F/°C ..... °F

b. Move TEST dvm + Lead to U3607-6 on conditioner board.

c. Push and hold TEMP TEST while making following adjustment.

d. **ADJUST**—△T (R3732, Conditioner board) for a test dvm reading of 0.00 V.

e. **CHECK**—413A digital display is +1.0 to -1.0 while TEMP TEST button is held in.

f. Set 413A °F/°C to °C.

g. **CHECK**—413A digital display is +0.6 to -0.6 while TEMP TEST button is held in.

h. Release TEMP TEST button.

i. Insert 77° F/25° C Temperature Sensor Simulator in 413A TEMP A input. Insert 113° F/45° C simulator in TEMP B input.

j. **CHECK**—413A digital display is -19.4 to -20.6.

k. Set 413A °F/°C switch to °F.

l. **CHECK**—Digital display is -35 to -37.

C9. CHECK RESPONSE TIME

a. Set 413A TEMPERATURE A button in. Digital readout should be about 77° F.

b. **CHECK**—Digital display settles to within 0.2° of its final reading (about 101.3) within two seconds after TEMP TEST button is pushed.

D. PRESSURE/PULSE

Equipment Required

1. Digital Voltmeter (test dvm).
2. Stereo Phone Plug
3. Function Generator
4. Pulse Sensor (Fig. 4-4)
5. Pulse Test Fixture
6. Test Oscilloscope
7. Pressure Transducer
8. Manometer
9. Optional Pressure Transducer Simulator (Fig. 4-3)

D1. PRESSURE/PULSE PRELIMINARY SETUP

a. Set 413A controls:

MONITOR ..... In (on)
PRESSURE/PULSE ALARM ..... Out (off)
PRESSURE/PULSE TRACE OFF ..... In (off)
PRESURE 125 ..... In
MEAN ..... In
RESP TRACE OFF ..... Out (on)
RESP SIZE ..... CCW (off)
ECG CHANNEL OFF ..... In (off)
LOW HEART RATE LIMIT ..... CCW (off)
LOW RESP RATE LIMIT ..... CCW (off)

b. Connect pressure input source to 413A rear panel PRESSURE TRANSDUCER INPUT connector. Either optional Pressure transducer simulator or a manometer and a pressure transducer may be used (see Fig. 4-3).

c. See TESTPOINT AND ADJUSTMENT LOCATIONS pullout page in Section 8, Diagrams and Circuit Board Illustrations.

D2. ADJUST GAUGE FACTOR (R3465)

a. Insert stereo phone plug in P/P RESP output on 413A rear panel.

b. Connect test dvm + lead to tip contact and - lead to barrel contact.

c. Set pressure input to 0 mmHg.

d. Push and adjust ZERO control for a test dvm reading of 0.0000 V within 0.0200 V. Record exact reading (including polarity) for later use.

e. Set pressure input to 125 mmHg.

f. **ADJUST**—Gauge Factor (R3465, Pressure/Pulse board) for a test dvm reading of 2.500 V + reading noted in part d. Record exact reading.

g. Set pressure input to 0 mmHg.

h. **CHECK**—Test dvm reading is 2.500 V (±0.0100 V) less than that noted in part f.

i. Disconnect test dvm and remove stereo phone plug.

D3. ADJUST TRACE ZERO (R3490) AND VERTICAL SENSITIVITY (R4125)

a. Set 413A PRESSURE/PULSE TRACE OFF button out (on).

b. Set pressure input to 0 mmHg.

c. Press 413A ZERO control and set for a 413A digital display of +0 or -0.

d. **ADJUST**—Trace Zero (R3468, Pressure/Pulse board) so that crt trace coincides with bottom graticule line.

e. Set pressure input to 125 mmHg.

f. **ADJUST**—Vertical Sensitivity (R4125, Main Board accessible through hole in conditioner board so that trace coincides with 125 mmHg graticule line.

g. **INTERACTION**—Between Trace Zero (R3468) and Vertical Sensitivity (R4125). Repeat parts b through f as needed.

D4. CHECK PRESSURE RANGE AND READOUT ACCURACY

a. **CHECK**—413A digital display and crt trace positions are within limits given in Table 4-6. Check readout accuracy both MEAN and SYST/DIAST settings.

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TABLE 4-6
Pressure Display and Readout Accuracy

413A PRESSURE RANGE	PRESSURE INPUT RANGE	TRACE POSITION[a]	READOUT LIMITS
125	0	0 ±2.5 mm	0[b]
	125	125 ±2.5 mm	+122 to +128
25-75	25	25 ±2.5 mm	+22 to +28
	75	75 ±2.5 mm	+72 to +78
25	0	0 ±6 mm	0**
	25	25 ±6 mm	+22 to +28

[a] Limits are mm as measured with a ruler, no mmHg

[b] Set to +0 or −0 with control (pushed ZERO). All other limits given in this column assume correct ZERO control setting.

D5. CHECK RIPPLE AND RESPONSE TIME

a. Connect + lead of test dvm to P2400-26 (Systolic Filter output). Connect − lead of test dvm to GND testpoint on conditioner board.

b. Set pressure input to 25 and allow test dvm reading to settle.

c. Push and release 413A 100 mm TEST button once every two seconds until instructed to stop. Allow 30 seconds for filter to fully settle.

d. **CHECK**—Difference between high and low test dvm reading (ripple) is less than 20 mV (equivalent to 2 mmHg).

e. Continue pushing and releasing 100 mm TEST button and move test dvm + lead to P2400-10 (Diastolic Filter output). Continue pushing and releasing 413A 100 mm TEST.

f. **CHECK**—Difference between high and low test dvm readings is less than 20 mV.

g. Stop pushing 100 mm TEST.

h. Set pressure input to 0 mmHg. Allow 30 seconds for test dvm to settle.

i. Start timing and push and hold 100 mm TEST. When test dvm reading passes 0.950 V, stop timing.

j. **CHECK**—Measured interval (response time) is less than 12 seconds.

k. Release 100 mm TEST and move test dvm + lead to P2400-26 (Systolic Filter output). Allow 30 seconds for test dvm to settle.

l. Start timing and push and hold 100 mm CHECK. When test dvm reading passes 0.950 V, stop timing.

m. **CHECK**—Measured interval (response time) is less than 12 seconds.

n. Release 100 mm CHECK and move test dvm + lead to P2400-27 (MEAN Pressure Filter). Allow 30 seconds for test dvm reading to settle.

o. Start timing and push and hold 100 mm CHECK. When test dvm reding passes 0.950 V, stop timing.

p. **CHECK**—Measured interval (response time) is less than 12 seconds.

D6. CHECK PRESSURE/PULSE ALARM (PRESSURE MODE)

a. Set 413A:

PRESSURE/PULSE ALARM ..... (on)
ALARM LOUDNESS (rear panel) ..... midrange

b. Connect dvm + lead to P2400-10 (output of diastolic filter). Connect test dvm − lead to GND test point on conditioner board.

c. Push and release 413A 100 mm CHK about once a second.

d. After pushing and releasing 100 mm CHK for about 30 seconds, push it in and hold it while watching test dvm. When test dvm reading reaches 0.950 V, start timing. When alarm sounds, stop timing.

e. **CHECK**—Measured interval is 3 to 15 seconds.

f. CHECK ALARM light is on.

g. Set PRESSURE/PULSE ALARM out (off).

D7. CHECK Pulse Operation

a. Connect pulse sensor to 413A rear panel input.

b. Insert finger in pulse sensor.

c. **CHECK**—Pulse display can be obtained and audio beat occurs on each pulse.

d. Remove finger from pulse sensor and start timer.

e. When trace returns to screen, stop timing.

f. **CHECK**—Measured interval is 10 seconds or less.

D8. CHECK PRESSURE/PULSE ALARM AND ALARM RESET

a. Insert finger in pulse sensor. Relax and obtain a stable pulse waveform. Set PULSE SIZE control fully CCW and verify that beat tone stops. If it doesn't, wrap your finger with a piece of tissue paper to reduce sensed pulse signal amplitude.

b. Set PRESSURE/PULSE ALARM button in (on).

c. Turn PULSE SIZE cw until beat tone is audible.

d. Set PULSE SIZE fully CCW and start timer. Beat tone should stop. When alarm sounds, stop timer.

e. **CHECK**—Measured time interval is 3 to 15 seconds.

D9. CHECK REAR PANEL PULSE OUTPUT AND PULSE SIZE RANGE

a. Insert pulse simulation fixture (see fig 4-4) in pulse sensor. Pack facial tissue cotton in opening of pulse sensor to prevent ambient light from affecting measurement.

b. Set function generator

Function ..... (sinewave)
DC Offset ..... CW
Amplitude ..... CCW (minimum)
Frequency Multiplier 1
Frequency Dial 1

Function generator frequency setting equals approximately 1 Hz to simulate a heart rate of 60 BPM.

c. Set 413A PULSE SIZE to midrange.

d. Set function generator amplitude so a pulse display becomes visible. If you can't get a pulse display, try repositioning LED or reducing value of series resistor. If pulse display is large and cannot be sufficiently reduced, increase value of series resistor.

e. Insert stereo phone plug in 413A rear panel P/P RESP output. Connect test oscilloscope probe to tip connector of phone plug.

f. Set function generator amplitude for a pulse display of 5 cm on 413A crt.

g. **CHECK**—Test oscilloscope display is 2.25 to 2.75 V (0.5 V ±10% per cm of 413A display).

h. Set 413A PULSE SIZE fully ccw.

i. **CHECK**—413A display is 1/3 cm or less.

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E. ECG

Equipment Required

1. Test Oscilloscope
2. ECG Patient Cable
3. Stereo Phone Plug
4. Function Generator
5. Precision Attenuator
6. Dc Power Supply
7. 0.47 μF Capacitor
8. BNC to Dual Binding Post Adapter
9. True Rms Digital Voltmeter.

E1. ECG PRELIMINARY SETUP

a. Set 413A controls:

MONITOR ..... In (on)
PRESSURE/PULSE ALARM ..... Out (off)
PRESSURE PULSE TRACE OFF ..... In (off)
RESP TRACE OFF ..... Out (on)
RESP SIZE ..... CCW (off)
ECG II ..... In
ECG SIZE ..... Index
LOW HEART RATE LIMIT ..... CCW (off)
LOW RESP RATE LIMIT ..... CCW (off)

b. Connect ECG patient cable to 413A ECG input. Connect patient leads to ECG/RESP LEAD TEST signal output on 413A side panel.

c. See TESTPOINT AND ADJUSTMENT LOCATIONS pullout page in Section 8, Diagrams and Circuit Board Illustrations.

E2. ADJUST INPUT OFFSET NULL (R3064)

a. Connect 10× probe from test oscilloscope to TP3004.

b. **ADJUST**—INPUT OFFSET NULL (R3064, ECG board) for 0.0 V within 0.2 V on TP3004 (ignore 20 mV ECG signal).

c. Disconnect 10× probe from TP3004.

E3. ADJUST DC LEVEL (R3004)

a. Insert stereo phone plug into ECG/RATE output on 413A rear panel.

b. Connect 10× probe from test oscilloscope to phone plug tip connector.

c. Set test oscilloscope:

Volts/Div ..... 500 mV
Time/Div ..... 20 ms
Input Coupling ..... GND
Trigger Mode ..... AUTO

d. Set test oscilloscope Vertical Position control to set trace to center graticule line.

e. Set test oscilloscope:

Input Coupling ..... DC
Trigger Mode ..... NORM

f. **ADJUST**—DC LEVEL (R3004, ECG board) so bottom of test oscillloscope display returns to center graticule line.

g. Disconnect test oscilloscope.

E4. CHECK QRS TIMER DURATION AND QRS INHIBIT/TRIGGER DURATION

a. Connect test oscilloscope CH 1 probe to TP3021 on ECG Board.

b. Connect test oscilloscope CH 2 probe to TP3040 on ECG Board.

c. Set test oscilloscope:

Ch 1 Volts/Div ..... 1 V
Ch 2 Volts/Div 5
Vertical Mode ..... CHOP
Time/Div ..... 20 ms
×10 Magnifier ..... ON (×10)
Trigger Source ..... CH 1
Trigger Slope ..... +
Trigger Mode ..... NORM

d. Set test oscilloscope position control to set left end of trace to left edge of graticule.

e. **CHECK**—First visible positive going edge of CH 2 waveform is 4 to 6 ms from left edge of trace (see Fig. 4-13).

f. Set test oscilloscope:

×10 Magnifier ..... OFF (×1)
Time/Div ..... 20 ms

g. **CHECK**—Duration of positive portion of CH 2 signal is 125 to 175 ms (see Fig. 4-14).

h. Disconnect test oscilloscope.

E5. CHECK PACER REJECTION

a. Connect output of function generator to rear lead test output through a 0.47 μF capacitor (see Fig. 4-15).

b. Set function generator:

Frequency ..... 1 Hz
Amplitude ..... 0.5 V p-p

c. Set 413A BEAT LOUDNESS for an audible QRS indication.

NOTE

When a simulated pacer occurs very close to a QRS signal, QRS indication may be inhibited.

d. **CHECK**—QRS indication occurs on QRS signals but not on simulated pacer signals.

e. Disconnect function generator and capacitor from test signal output.

E6. CHECK LEAD FAULT

a. Disconnect RA (white lead) from 413A TEST signal output.

b. **CHECK**—ECG display is off screen and LEAD FAULT light is on.

c. Reconnect RA lead to 413A TEST SIGNAL output and disconnect LA lead (black).

d. **CHECK**—ECG display is off screen and LEAD FAULT light is on.

e. Reconnect LA lead.

f. **CHECK**—Display returns to crt anad QRS light begins flashing.

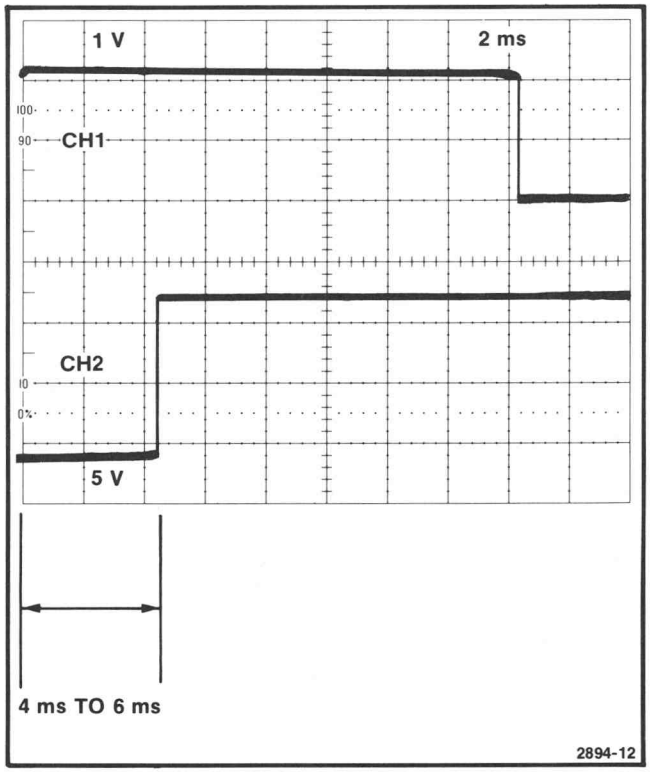

Fig. 4-13. QRS timer duration waveform.

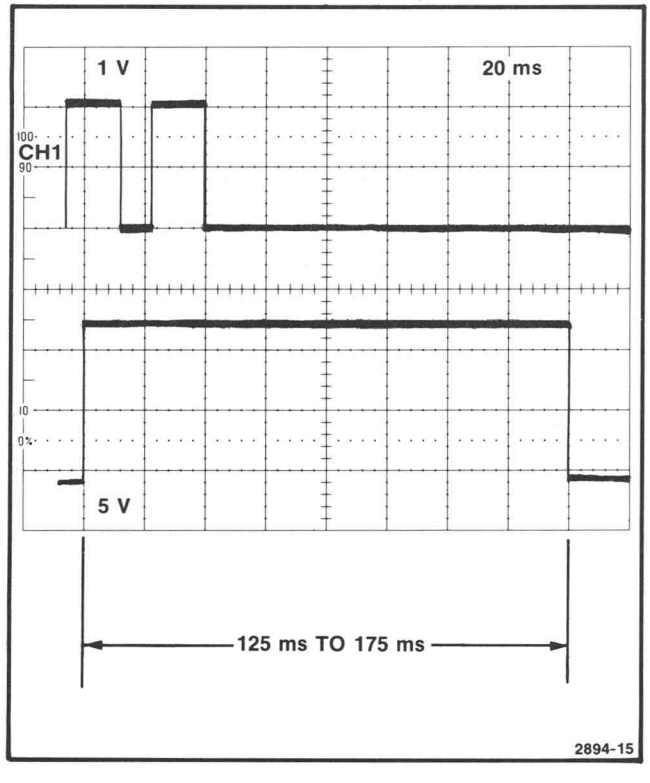

Fig. 4-14. QRS inhibit duration waveform.

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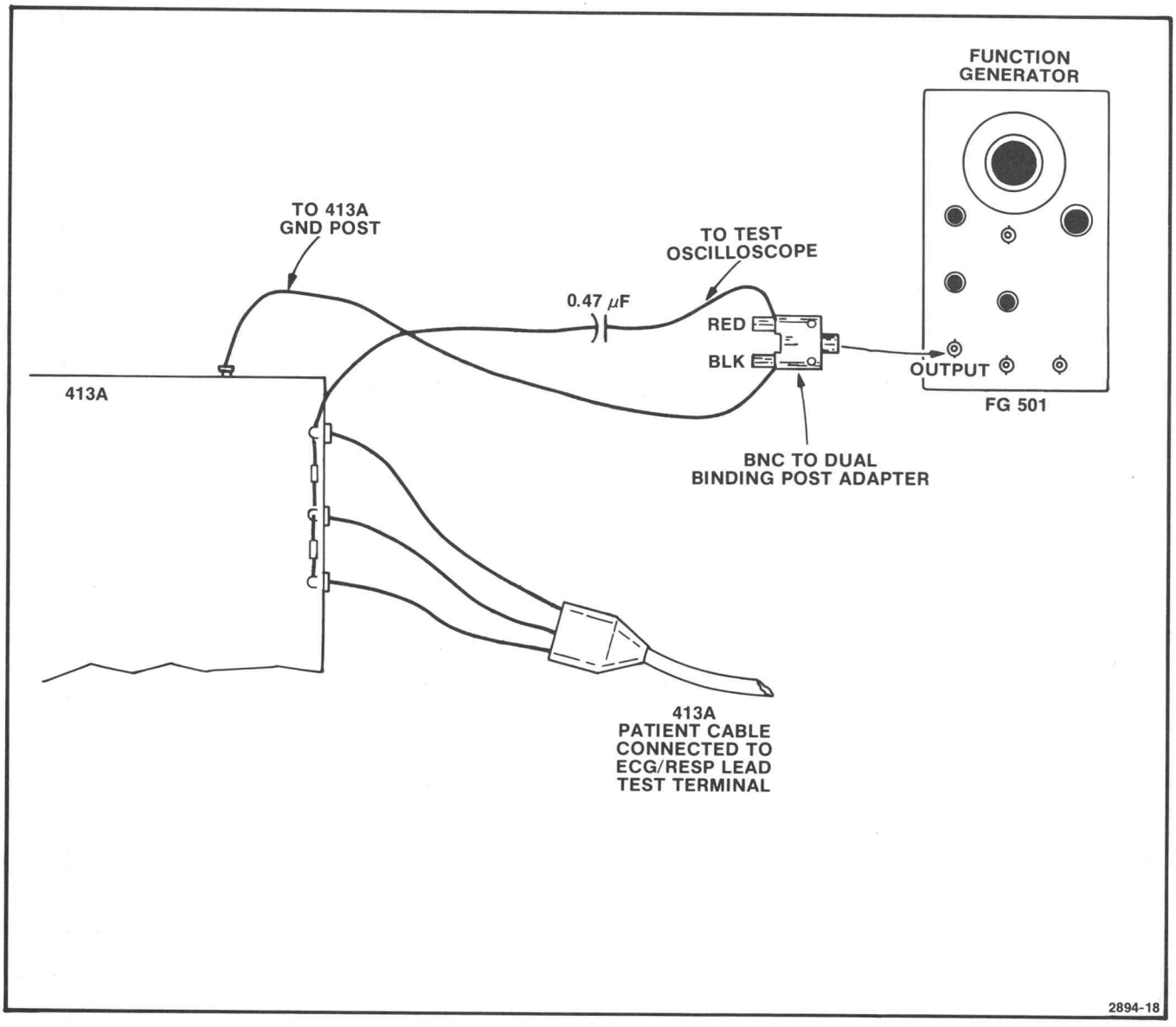

Fig. 4-15. Pacer test setup.

E7. ADJUST ECG GAIN (R3003)

a. Connect function generator to 413A ECG input through precision attenuator (see Fig. 4-5).

a. Insert stereo phone plug in 413A ECG/RATE output.

b. Set 413A:

ECG SIZE.....INDEX
ECG I.....In

c. Connect test oscilloscope probe to output of function generator.

d. Set test oscilloscope:

Volts/Div.....200 mV
Time/Div.....10 ms
Trigger Mode.....NORM

e. Set function generator:

Function.....(sinewave)
Frequency.....10 Hz
Amplitude.....for a 5-div display on test oscilloscope (1 V p-p)

f. Move test oscilloscope probe to tip connector of stereo phone plug (ECG OUT).

g. **ADJUST**—ECG GAIN (R3003, ECG board) for a 5 division display (I V p-p) on test oscilloscope.

h. Disconnect test oscilloscope. i. **CHECK**—ECG display amplitude is 1.8 to 2.2 cm.

j. Set function generator amplitude for exactly 2 cm of display on 413A crt.

k. Set 413A ECG SIZE fully cw.

l. **CHECK**—413A display amplitude is 4 cm or greater.

m. Set 413A ECG SIZE fully ccw.

n. **CHECK**—413A display amplitude is 1 cm or less.

E8. CHECK ECG BANDWIDTH AND DC OFFSET RANGE

a. Set 413A ECG SIZE to index.

b. Set function generator amplitude for a 413A display amplitude of 5 divisions (10 Hz).

c. Change function generator frequency toward 100 Hz until 413A display amplitude is 3.5 divisions.

d. **CHECK**—function generator frequency is 37.5 to 62.5 Hz (period 16.0 to 26.7 ms).

e. Set function generator frequency to 10 Hz. 413A display amplitude should still be 5 divisions.

f. Change function generator frequency toward 0.1 Hz until 413A display amplitude is 3.5 divisions.

g. **CHECK**—function generator frequency is 0.375 to 0.625 Hz (1.6 to 2.67 seconds).

h. Set function generator frequency to 10 Hz.

i. Connect dc power supply to DC offset input of Precision Attenuator (see Fig. 4-5).

j. Set Power Supply output to +10 V (divides to 250 mV at LA input of ECG.

k. **CHECK**—10 Hz sinewave is visible on 413A crt.

l. Set dc power supply output to -10 V.

m. **CHECK**—10 Hz sinewave is visible on 413A crt.

n. Disconnect precision attenuator dc power supply and function generator.

E9. CHECK ECG NOISE

NOTE

To accurately check ECG noise use a true rms digital voltmeter, such as Tektronix DM501A.

a. Connect rms voltmeter to rear panel ECG/rate output ring connection through low-pass filter (see Fig. 4-6).

b. Short three ECG leads together.

c. **CHECK**—True rms voltmeter reading is 10 mV or less (indicates noise is 10 μV or less with respect to input) ± tolerance of voltmeter.

d. Disconnect voltmeter and filter.

E10. ADJUST HEART RATE (R3650)

a. Connect function generator to ECG patient cable through ECG/Resp Test Fixture (see Fig. 4-1). Use frequency counter to verify output frequency of function generator. For greater accuracy, use period mode.

b. Set function generator frequency for squarewaves at 4 Hz ±1% (period of 247.5 to 252.5 ms). Allow at least 15 seconds after changing function generator frequency before making adjustment to allow filters to settle.

c. Connect test dvm + lead to P2400-11 and - lead to GND testpoint on conditioner board.

d. **ADJUST**—Heart Rate (R3650, Conditioner board) for a test dvm reading of 2.400 volts.

e. Set 413A HEART RATE/MIN button in.

f. **CHECK**—413A Readout corresponds to limits given in Table 4-7. Allow at least 15 seconds after changing frequency before making measurements.

g. Set function generator frequency to 0.5 Hz (period of 2 seconds).

h. **CHECK**—413A digital display ripple is 2 bpm or less. Ripple is periodic increase and decrease in digital display due to filters in Rate Converter.

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TABLE 4-7
Heart Rate Readout Limits

GENERATOR		413A READOUT	
FREQ	PERIOD	LOW	HIGH
4	250 ms	245	255
3	333 ms	176	184
2	500 ms	117	123
1	1 sec	57	63

E11. CHECK HEART RATE RESPONSE TIME.

a. Set function generator frequency for a period of 300 ms (3.3 Hz or 200 BPM).

b. Allow 413A display to settle.

c. Disconnect cable from frequency generator at same time you start timing. When 413A display reaches 10, stop timing.

d. **CHECK**—Measured time interval is 12 seconds or less.

e. Reconnect cable to function generator.

E12. CHECK HEART RATE OUTPUT

a. Insert stereo phone plug in ECG/RATE output on 413A rear panel.

b. Verify function generator still set to about 3 Hz and beat note is audible on each simulated ECG signal.

c. Connect test oscilloscope probe to ring connection of stereo phone plug.

d. **CHECK**—Test oscilloscope waveform is a positive going pulse about 5.5 V in amplitude. Duration of positive going portion should be 63 to 73 ms.

E13. CHECK HEART RATE ALARM

a. Set function generator frequency to 2 Hz.

NOTE

Test assumes a 413A readout of 120 BPM. If it isn't, slightly readjust function generator frequency as needed. Allow 413A reading to stabilize at 120 before continuing.

b. Insert stereo phone plug in 413A ALARM output on 413A rear panel.

c. Set 413A:

HIGH HEART RATE LIMIT ..... Fully cw
LOW HEART RATE LIMIT 117

d. **CHECK**—Alarm does not sound (allow about 2 sec).

e. Set 413A LOW HEART RATE LIMIT clockwise to 123 or greater and start time measurement.

f. **CHECK**—Alarm sounds and Alarm indicator lights in 3 to 15 seconds.

g. Connect test dvm + lead to ring connector of stereo phone plug in ALARM output. Connect - lead to barrel connection.

h. **CHECK**—Test dvm reads about +5.5 V. Leave dvm connected to ring.

i. Push and release ALARM RESET. Start time measurement when RESET pushed.

j. **CHECK**—After RESET is pushed, alarm audio stops, test dvm reading drops to about 0 V, and ALARM indicator stays on.

k. **CHECK**—Audio alarm returns and test dvm reading goes to about 5.5 V within 30 to 60 seconds after ALARM RESET is pushed.

l. Push and slowly readjust LOW HEART RATE LIMIT counterclockwise until audio alarm stops.

m. **CHECK**—LOW HEART RATE LIMIT control is set to 118 to 122 when audio alarm stops.

n. **CHECK**—ALARM indicator is still on and test dvm still reads about 5.5 V after audio alarm stopped.

o. Short stereo phone plug tip connection to barrel connection.

p. **CHECK**—ALARM indicator went out and test dvm reading dropped to about 0 V when phone plug contacts were shorted.

q. Set 413A:

LOW HEART RATE LIMIT 100
HIGH HEART RATE LIMIT 123

r. **CHECK**—Audio alarm does not sound (allow 20 seconds).

s. Set HIGH HEART RATE LIMIT ccw to 117 or less and start time measurement.

t. **CHECK**—Audio alarm sounds in 3 to 15 seconds.

u. Slowly readjust HIGH HEART RATE LIMIT clockwise until audio alarm stops.

v. **CHECK**—HIGH HEART RATE LIMIT is set to 118 to 122.

w. **CHECK**—HEART RATE ALARM LIMIT setting readout falls within limits given in Table 4-8.

x. Set 413A

HIGH HEART RATE ..... CW
LOW HEART RATE ..... CCW (off)

TABLE 4-8
Heart Rate Limit Control Range

CONTROL	SETTING	READOUT LIMITS
HIGH HEART	CW	245 to 255
	CCW	96 to 104
LOW HEART	CW	146 to 154
	CCW	0 to 3

y. Disconnect stereo phone plug and test dvm.

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F. RESPIRATORY EFFORT

Equipment Required

1. Precision Attenuator (Fig. 4-5)
2. True Rms digital voltmeter
3. Test Oscilloscope
4. Function generator (2 required)
5. Patient Cable
6. Resp Low-Pass Filter (Fig. 4-6)
7. ECG/Resp Test Fixture (Fig. 4-1)

F1. RESPIRATORY EFFORT

PRELIMINARY SETUP

a. Set 413A MONITOR pushbutton out (off) and remove 413A Respiration board.

b. Connect pin 2 and 8 of U3228 together through a 10 kΩ resistor.

NOTE

This disables the low ECG Rate detector. This is necessary to allow checking the respiratory effort arrest alarm, the respiratory effort rate alarm, and the CVA detector without interference from the low ECG rate detector. The resistor will be removed in step 13.

c. Reinstall 413A Respiration board.

d. Set 413A control:

MONITOR ..... in (on)
PRESSURE/PULSE ALARM ..... Out (off)
PRESSURE/PULSE TRACE OFF... In (off) RESP TRACE OFF .....Out (on)
RESPIRATORY EFFORT SIZE .....Index
ECG CHANNEL OFF ..... In (off)
LOW HEART RATE LIMIT ..... CCW (off)
LOW RESP RATE LIMIT ..... CCW (off)

e. Connect ECG patient cable to 413A ECG input and connect precision attenuator to patient cable.

f. See TESTPOINT AND ADJUSTMENT LOCATIONS pullout page in Section 8, Diagrams and Circuit Board Illustrations.

F2. CHECK EXCITATION FREQUENCY

a. Set 413A:

ECG CHANNEL OFF ..... IN (Off)
RESP SIZE..... At Index
RESP TRACE OFF ..... OUT (On)

b. Connect test oscilloscope probe tip to one side of 1kΩ resistor in precision attenuator. Connect probe ground to other side of 1 kΩ resistor. Input of precision attenuator should not be connected to a generator for this check.

c. Set test oscilloscope:

Volts/Div ..... 50 mV
Time/Div ..... 5 μs

d. **CHECK**—Test oscilloscope waveform amplitude is 100 to 300 mV peak to peak and period is 20 μ sec (50 kHz).

e. Disconnect precision attenuator and reconnect patient cable to ECG/RESP test fixture.

F3. ADJUST NULL (R3206)

a. Set ECG/RESP test circuit S1 open and S2 closed. This sets simulated chest impedance to 750 Ω (15 μF capacitor impedance is 0.2 Ω at 50 kHz).

b. Connect test oscilloscope probe to TP3232 on Respiration board.

c. Set test oscilloscope:

Volts/Div .....500 mV
Time/Div ..... 5 μs
Input Coupling ..... GND

d. Set test oscilloscope Vertical position to move trace to center graticule line.

e. Set test oscilloscope input coupling to DC.

f. **ADJUST**—NULL (R3206, Respiration board) to reposition test oscilloscope trace of center graticule line.

F4. ADJUST BALANCE (R3203)

a. Insert stereo phone plug in P/P RESP OUTPUT on 413A rear panel.

b. Connect test oscilloscope probe tip to stereo phone plug ring connection. Connect probe ground to phone plug barrel connection.

c. **ADJUST**—BALANCE (R3203, Respiration Board) for 0.0 V within 25 mV on ring connection.

d. Leave test oscilloscope connected to phone plug ring connector.

F5. ADJUST GAIN (R3205)

a. Connect function gennerator output to Resp Gate input of ECG/RESP test fixture. b. Set ECG/RESP test fixture switches:

S1 ..... Open
S2 ..... Closed
S3 ..... Open

c. Set function generator:

Frequency ..... About 1 Hz
Function ..... Squarewave
DC Offset ..... 0 V
Amplitude ..... About 10 ±2 V

d. **ADJUST**—GAIN (R3205, respiration board) for a test oscilloscope transition amplitude of 500 mV.

e. **CHECK**—Transition amplitude of 413A crt display is 0.75 to 1.25 cm (with RESP SIZE set to index). Note exact amplitude. Measure between points on waveform as shown in Figure 4-16.

f. Set RESP SIZE fu0ly ccw but not in detent.

g. **CHECK**—413A respiration display amplitude is one fourth or less than that noted in part d.

h. Set RESP SIZE fully cw.

i. **CHECK**—413A Respiration display amplitude is 4 times or greater than that noted in part d.

j. Disconnect test oscilloscope.

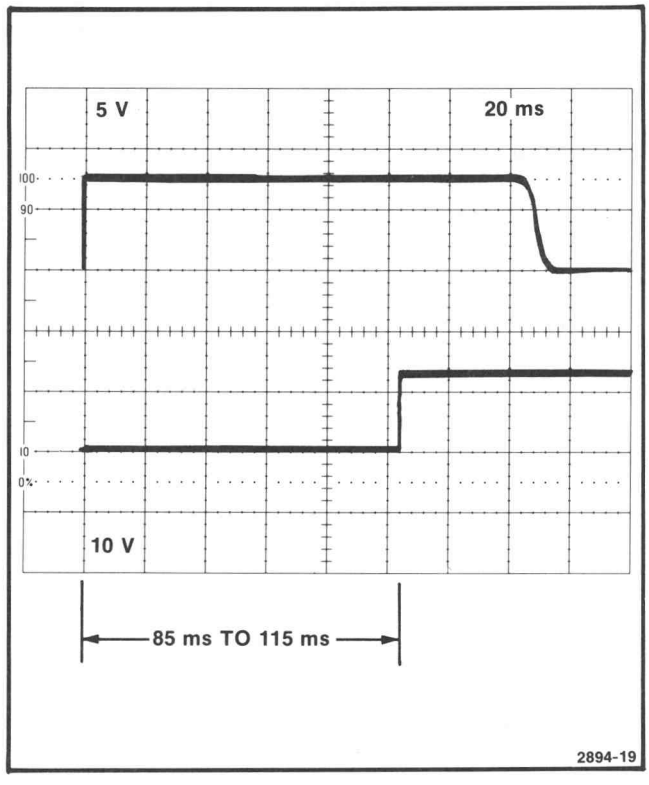

Fig. 4-16. Inspiration timer duration waveform.

F6. CHECK INSPIRATION TIMER DURATION AND INSPIRATION INHIBIT DURATION

a. Connect test oscilloscope CH 1 probe to TP3212 on Respiration Board.

b. Connect test oscilloscope CH 2 probe to TP3210 on Respiration Board.

c. Set test oscilloscope:

Ch 1 Volts/Div 5
Ch 2 Volts/Div 10
Vertical Mode ..... CHOP
Time/Div ..... 20 ms
Trigger Source ..... CH 1
Trigger Slope ..... +
Trigger Mode ..... NORM

@

d. Set test oscilloscope vertical position controls to obtain a display similar to fig. 4-17.

e. **CHECK**—Time between positive transition of CH 1 waveform and positive transition of CH 2 waveform 85 to 115 ms (4.25 to 5.75 divisions).

f. Set test oscilloscope trigger slope to − to obtain waveforms shown in fig. 4-18.

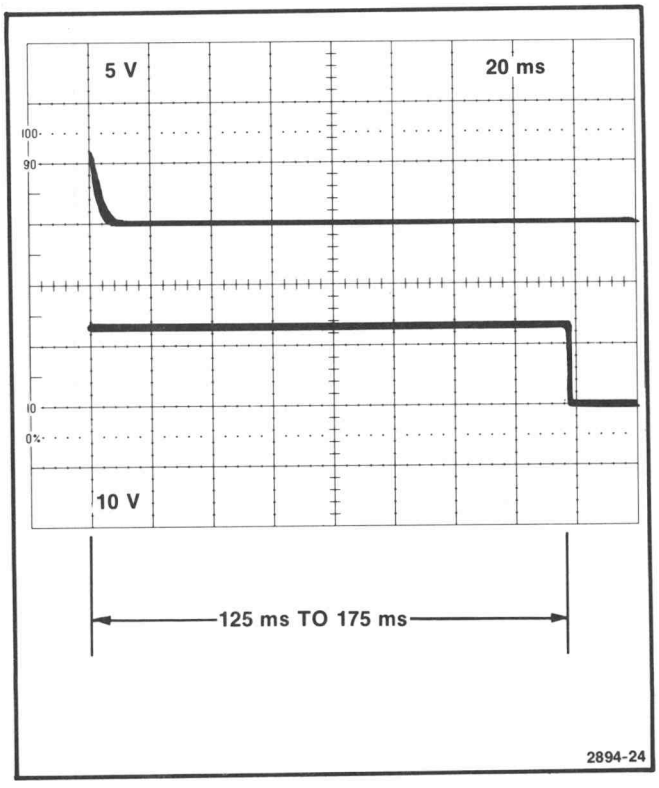

Fig. 4-17. Inspiration inhibit duration waveform.

g. **CHECK**—Time between negative transition of CH 1 waveform and negative transition of CH 2 waveform is 125 to 175 ms (6.25 to 8.75 divisions).

h. Disconnect test oscilloscope.

F7. CHECK CHEST IMPEDANCE RANGE

a. Verify that ECG/RESP test fixture S1 is open and S2 is closed.

b. Set S2 open.

c. **CHECK**—Respiration display returns to 413A display within 5 seconds of setting S2 open.

d. **CHECK**—INSPIRATION indicator begins flashing on each simulated RESP pulse within 30 seconds of opening S2.

e. Set both S1 and S2 closed.

f. **CHECK**—Respiration display returns to 413A display within 5 seconds of closing S1 and S2.

g. **CHECK**—INSPIRATION indicator begins flashing within 30 seconds of closing S1 and S2.

h. Set S1 open and S2 closed.

F8. ADJUST RESP RATE (R3656)

a. Set function generator frequency to 2 Hz ±1%. (Period of 495 to 505 ms.) Allow filters to settle for 30 seconds before making adjustment.

b. Connect test dvm + lead to P2400-33. Connect test dvm − lead to GND test point on conditioner board.

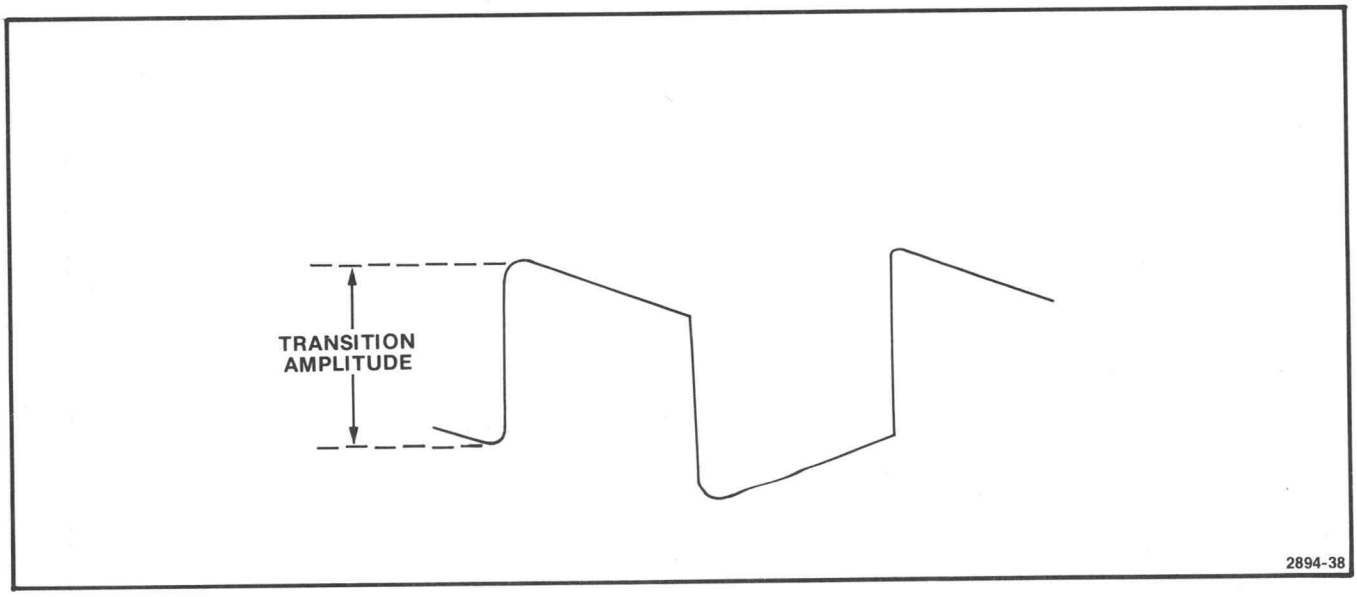

Fig. 4-18. Respiratory effort waveform transition amplitude measurement points.

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c. **ADJUST**—RESP RATE (R3656, conditioner board).

d. Set 413A RESP RATE/MIN button in.

e. **CHECK**—413A digital readout corresponds to limits given in Table 4-9.

TABLE 4-9
Heart Rate Accuracy

GENERATOR		413A READOUT	
Frequency	Period	Low	High
2	500 ms	117	123
1	1 sec	57	63
0.5	2 sec	27	33
0.25	4 sec	12	18

f. Set function generator frequency to 0.0833 Hz. (Period of 12 seconds or 5 bpm.) Allow 30 seconds for filters to settle.

g. **CHECK**—413A digital display ripple is 2 counts or less. Ripple is the periodic increase and decrease in digital display due to filters in rate converter.

F9. CHECK RESP RATE RESPONSE TIME

a. Set function generator frequency for a period of 600 ms (1.66 Hz or 100 bpm).

b. Allow 60 seconds for 413A display to settle.

c. Set S3 closed at same time you start timing. When 413A display reaches 5, stop timing.

d. **CHECK**—Measured time interval is 35 seconds or less.

e. Set S3 open.

F10. CHECK RESP RATE ALARM

a. Set function generator frequency to 1 Hz.

NOTE

Test assumes a 413A readout of 60 breaths per minute. Readjust function generator frequency as needed to obtain a stable reading of 60 before continuing.

b. Set 413A:

ALARM LOUDNESS ..... MIDRANGE
HIGH RESP RATE LIMIT ..... Fully cw
LOW RESP RATE LIMIT 57

c. **CHECK**—Alarm does not sound. Allow 20 seconds.

d. Set 413A LOW RESP RATE LIMIT clockwise to 63 or greater and start time measurement.

e. **CHECK**—Alarm sounds and ALARM indicator lights in 3 to 15 seconds.

f. Push and slowly readjust LOW RESP RATE LIMIT counterclockwise until audio alarm stops.

g. **CHECK**—LOW RESP RATE LIMIT control is set to 58 to 62 when audio alarm stops.

h. Set 413A:

LOW RESP RATE LIMIT 5
HIGH RESP RATE LIMIT 63
ALARM RESET ..... Push and Release

i. Wait 60 seconds to ensure ALARM RESET timer has timed out.

j. Set HIGH RESP RATE LIMIT counterclockwise to 57 or less and start time measurement.

k. **CHECK**—Audio alarm sounds in 3 to 15 seconds.

l. Slowly readjust HIGH RESP RATE LIMIT clockwise until audio alarm stops.

m. **CHECK**—HIGH RESP RATE LIMIT is set to 58 to 60 when audio alarm stops.

n. **CHECK**—RESP RATE ALARM LIMIT setting readout falls within limits given in Table 4-10.

TABLE 4-10
Resp Rate Alarm Limits Range

CONTROL	SETTING	READOUT LIMITS
HIGH RESP	CW	117 to 123
	CCW	0 to 3
LOW RESP	CW	72 to 78
	CCW[a]	0 to 3

[a] Not in detent

o. Set 413A:

HIGH RESP RATE LIMIT ..... CW
LOW RESP RATE LIMIT ..... CCW (off)

F11. CHECK RESPIRATORY EFFORT ARREST ALARM

a. Set 413A:

RESPIRATORY EFFORT ARREST ALARM .....IN (On)
RESPIRATORY EFFORT
ARREST ALARM DELAY .....IN (10 sec)
ALARM LOUDNESS .....Midrange

b. Watch 413A INSPIRATION indicator. Just after it flashes, close S3 on ECG/RESP test fixture and start time measurement.

c. **CHECK**—Audio alarm sounds in 7 to 13 seconds.

d. Watch INSPIRATION indicator and open S3.

e. **CHECK**—Audio alarm stops on second flash of INSPIRATION indicator.

f. Push ALARM RESET. Alarm light should go out.

g. Set RESPIRATORY EFFORT ARREST ALARM DELAY

h. Watch INSPIRATION indicator. Just after it flashes, close S3 on test fixture and start time measurement.

i. **CHECK**—Audio alarm sounds in 14 to 26 seconds.

j. Watch INSPIRATION indicator and open S3.

k. **CHECK**—Audio alarm stops on third flash of INSPIRATION indicator.

l. Set function generator frequency to 0.1 Hz (period of 10 seconds).

m. **CHECK**—Audio alarm sounds (after DELAY runs out). After sounding, audio alarm should be continuous (check through at least 4 flashes of INSPIRATION indicator).

n. Connect 1× probes to CH A and CH B inputs of frequency counter. Connect both probe tips to TP3627 (breath to breath timer) on Conditioner Board.

o. Set frequency counter:

FUNCTION ..... TIME A to B
CLOCK RATE ..... 1 ms
A and B COUPL .....DC
A SLOPE .....+
B SLOPE .....–
A and B LEVEL .....Midrange

p. Verify Audio alarm is still sounding and function generator frequency is still set to 0.1 Hz.

q. **CHECK**—Interval measured by frequency counter (breath to breath timer duration) 4 to 6 seconds.

r. Set RESPIRATORY EFFORT ARREST ALARM DELAY button in (10 sec).

s. **CHECK**—Audio alarm continues to sound. CHECK through at least three flashes of INSPIRATION indicator.

t. **CHECK**—Interval measured by frequency counter is 5 to 9 seconds.

u. Move frequency counter probes to TP3655 (qualifier timer).

v. Close S3 on ECG/RESP test fixture. Set function generator frequency to 0.5 Hz.

w. Push and release frequency counter reset.

x. Open S3.

y. When audio alarm stops, Close S3.

z. **CHECK**—Interval measured by frequency counter (qualifier timer duration) is 3 to 5 seconds.

aa. Set RESPIRATORY EFFORT ARREST ALARM button out (off).

ab. Disconnect frequency counter.

ac. Open S3.

F12. CHECK CVA REJECTION

a. Connect test equipment as shown in Fig. 4-19.

b. Set 413A:

SWEEP SPEED ..... 100 mm/SEC
ECG I
ECG SIZE .....Midrange
RESP SIZE .....Midrange
RESP TRACE OFF ..... OUT (On)

c. Set Generator A:

Function ..... Squarewave
Frequency ..... 0.6 Hz
DC OFFSET .....0 V
OUTPUT Amplitude ..... For a 2 to 3 cm ECG display on 413A

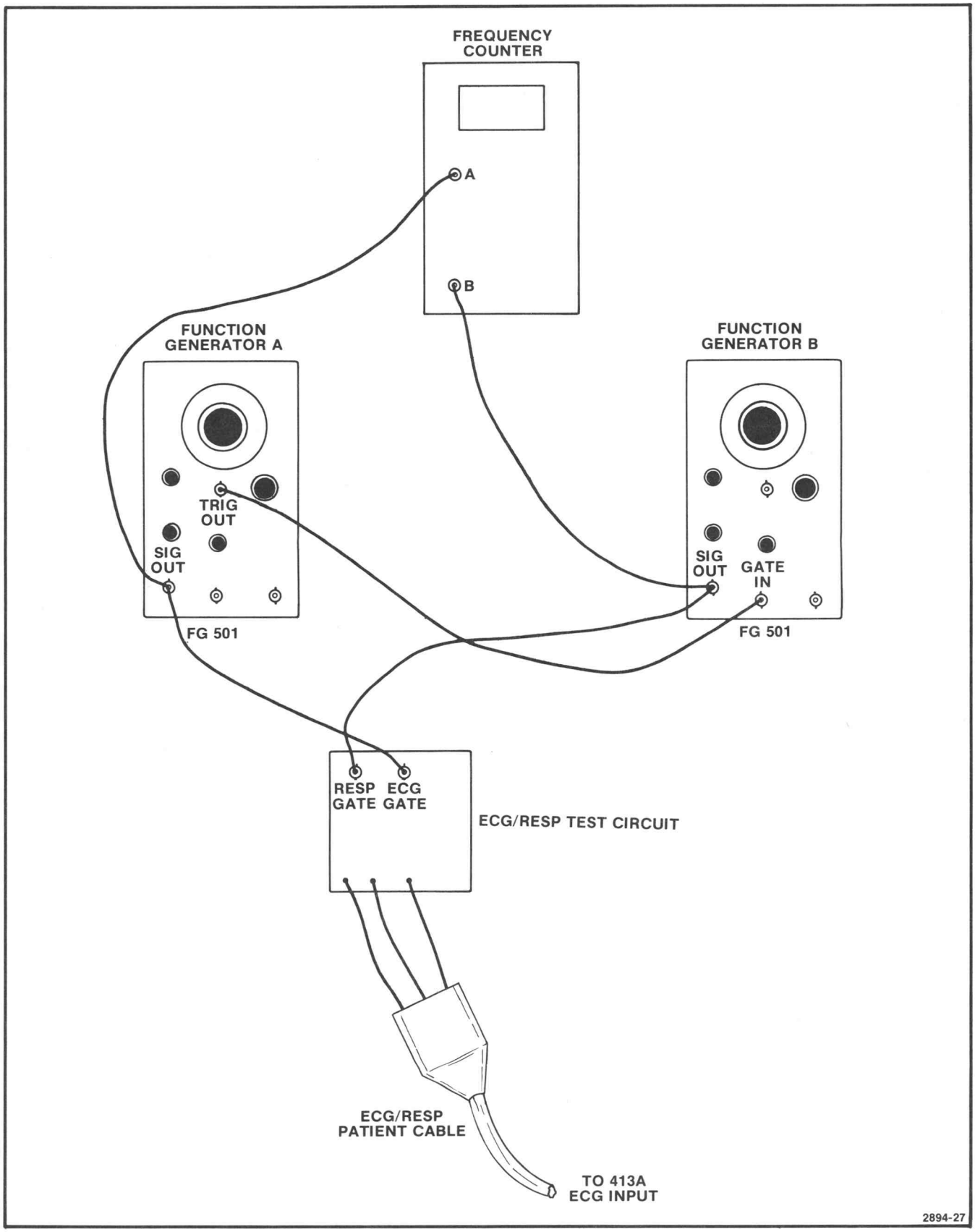

Fig. 4-19. Test setup to check CVA rejection.

d. Set Generator B:

Function ..... Squarewave
Frequency ..... 1 Hz
OUTPUT Amplitude ..... About 5 V p-p
DC OFFSET 0
PHASE Knob ..... Pulled out and set to midrange

At this point the 413A crt display should look like that shown in Figure 4-20.

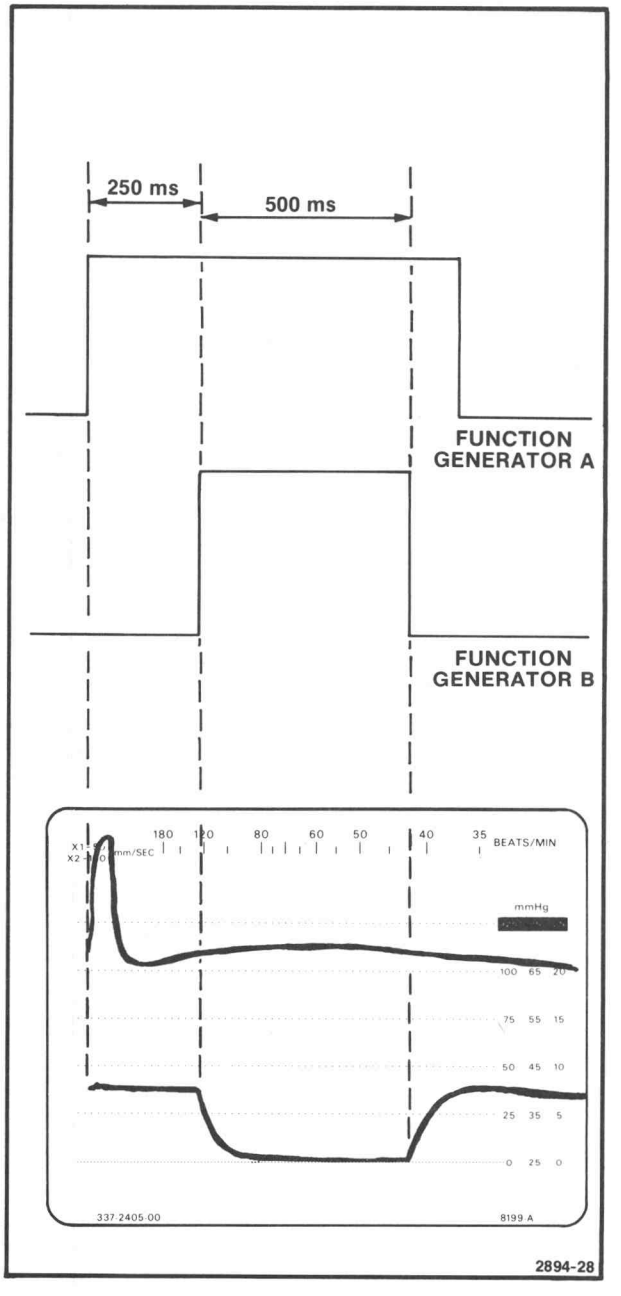

Fig. 4-20. CVA test waveforms.

e. Set frequency counter:

Function ..... TIME A–B
A and B SLOPE ..... +
CLOCK RATE ..... 1 μsec (ccw)

NOTE

The frequency counter must trigger on the positive-going slopes of both waveforms. However, it is sometimes possible to set the LEVEL control to trigger on the minus slope even if the SLOPE buttons are set to positive. To aid in setup, the Table 4-11 gives the possible frequency counter reading when the PHASE control on the B generator is set to midrange. Figure 4-20 shows the corresponding waveforms.

TABLE 4-11
Possible Frequency Counter Error Due to Triggering Error

ACUTAL TRIGGERING SLOPE		COUNTER READING
A	B	
+	+	≈250 ms
+	–	≈700 ms
–	+	≈100 ms
–	–	≈1500 ms

f. Set Generator B phase control for a frequency counter reading of 25 to 30 ms.

g. Close S3 on ECG/RESP test fixture through at least one flash of QRS indicator. This reset the CVA detector.

h. Just after QRS indicator flashes, open S3.

i. **CHECK**—Inspiration indicator flashes 3 or 4 times, then stops. The number of flashes is dependent on the instant you switch S3. In most cases, 3 flashes occur.

j. Set Generator B phase knob for a frequency counter reading of 240 to 245 ms.

k. **CHECK**—INSPIRATION indicator does not flash.

l. Set Generator B phase control for a frequency counter reading of 320 to 325 ms.

m. **CHECK**—INSPIRATION INDICATOR flashes on every positivegoing transition of simulated respiration signal.

n. Leave test setup connected for step F13.

F13. CHECK LOW ECG RATE DETECTOR

a. Set 413A MONITOR button out (off) and remove Respiration board.

b. Remove 10 kΩ resistor between pins 2 and 8 of U3228 (added in previous step).

c. Reinstall Respiration board.

d. Set 413A:

MONITOR ..... In (on)
RESP EFFORT ARREST ALARM ..... In (on)
DELAY ..... In (20 sec)

e. Set function generator B phase control for a frequency counter reading of 125 to 175 ms.

f. **CHECK**—Audio alarm sounds and INSPIRATION light flashes (there may be a slight delay until these conditions stabilize).

g. Set ARREST ALARM button out (off).

h. **CHECK**—Audio alarm stops.

i. Set RESPIRATORY EFFORT LOW RATE ALARM LIMITS control clockwise just out of detent.

j. **CHECK**—Audio alarm returns.

k. Push generator B Phase control.

l. Set frequency counter function switch to PERIOD B.

m. Disconnect BNC cable from frequency counter CH B input. Move the BNC cable from CH A input to CH B input (function generator A should now be connected to frequency counter CH B input).

n. Set generator A frequency to 0.833 Hx (50 bpm) by adjusting for a frequency counter reading of 1190 ms to 1210 ms.

o. **CHECK**—Audio alarm does not turn off (allow 20 secs).

p. Set generator A frequency to 1.17 Hz (70 bpm) by adjusting for a frequency counter reading of 850 to 865 ms.

q. **CHECK**—Audio alarm stops (allow about 20 secs).

r. Set generator A frequency to 2 Hz (frequency counter reading of 490 to 510 ms).

s. Allow about 60 seconds for C3232 to fully charge.

t. Set ECG II button in and begin time measurement (ECG trace will be a flat line with ECG II button in. When audio alarm sounds, stop time measurement.

u. **CHECK**—Measured interval is 2 to 8 seconds.

F14. CHECK RESPIRATORY EFFORT BANDWIDTH

a. Insert stereo phone plug in PP/RESP OUTPUT on 413A rear panel.

b. Connect test oscilloscope probe to ring connector of phone plug. Connect probe ground to barrel connection.

c. Connect ×10 probe tip to center connection of resp gate input of ECG/Resp test fixture (function generator B output). Connect BNC end of probe to test oscilloscope external trigger input.

d. Set test oscilloscope:

Volts/Div ..... 100 mV
Input Coupling ..... GND
Time/Div ..... 200 ms
Trig Mode ..... Auto
Trig Coupling ..... AC LF REJ
Trig Slope ..... –

e. Position left end of oscilloscope trace to bottom line and left edge of graticule.

f. Set test oscilloscope:

Input Coupling ..... DC
Trigger Mode ..... NORM
Trigger Source ..... EXT

g. Set function generator B frequency to 0.1 Hz.

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h. Set 413A RESP SIZE to obtain a test oscillloscope display amplitude of 8 divisions (see Fig. 4-21.). Waveform occurs at 10 second intervals.

i. **CHECK**—Test oscilloscope waveform crosses right edge of graticule within window shown in Fig. 4-21.

j. Set Generator B frequency to 2 Hz.

k. Set test oscilloscope time/div to 20 ms.

l. Set 413A RESP SIZE for a 5 division display on test oscilloscope.

m. **CHECK**—Risetime (10% to 90%) of test oscilloscope waveform is 56 to 93 ms (see Fig. 4-22).

n. Disconnect test oscilloscope. Leave stereo phone plug inserted in P/P/RESP OUTPUT.

F15. CHECK RESPIRATORY EFFORT NOISE

a. Disconnect patient cable from test circuit.

b. Connect 750 Ω 5% resistor between LA and RA leads of patient cable.

c. Connect true rms dvm to ring connection of stereo phone plug through Low-Pass Filter (see Fig. 4-7).

d. Set RESP SIZE to index.

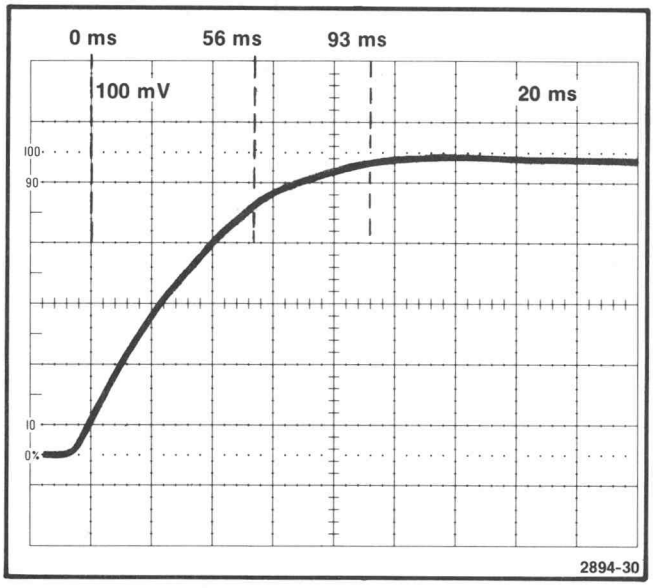


Fig. 4-22. Respiratory effort risetime waveform.

e. **CHECK**—True rms dvm reading is 12.5 mV rms or less.

f. Disconnect dvm and low-pass filters.

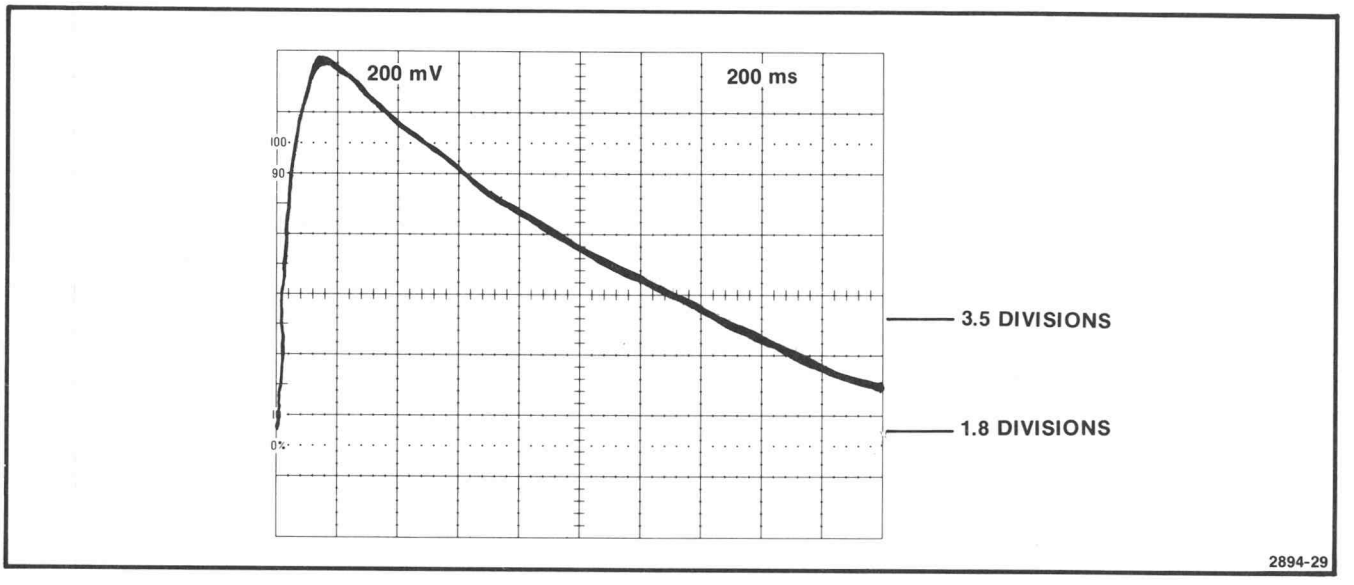


Fig. 4-21. Respiratory effort bandwidth droop waveform.

G. CMRR AND LEAKAGE

Equipment Required

1. ECG CMRR Fixture (Fig. 4-8)
2. Safety Analyzer

CMRR AND LEAKAGE PRELIMINARY SETUP

a. Set 413A controls:

MONITOR ..... In (on)
PRESSURE/PULSE ALARM ..... Out (off)
PRESSURE/PULSE TRACE OFF ..... In (off)
RESP TRACE OFF ..... Out (on)
RESP SIZE ..... CCW (off)
ECG I ..... In
ECG SIZE ..... Index
All Alarms ..... Off

b. See TESTPOINT AND ADJUSTMENT LOCATIONS pullout page in Section 8, Diagrams and Circuit Board Illustrations.

G1. ECG CMRR CHECK

a. Connect CMRR test fixture (Fig. 4-8) to ECG INPUT connector. Then connect test circuit to mains power line.

b. Set ECG SIZE control to index.

c. Set ECG I button in.

d. **CHECK**—Monitor display ampitude should be less than 1.3 cm p-p for nominal 115 V lines (or less than 2.6 cm, p-p for nominal 230 V lines, if lines are unbalanced).

e. Set ECG III in.

f. Repeat part d.

g. Set ECG II in.

h. **CHECK**—Monitor display amplitude should be less than 1.9 cm p-p for nominal 115 V lines (or less than 3.8 cm, p-p for nominal 230 V lines, if lines are unbalanced).

i. Disconnect CMRR test fixture.

G2. CHECK LEAKAGE

a. Replace instrument covers. Leakage check is valid only with covers installed.

b. **CHECK**—ECG leakage current according to procedure supplied by Safety Analyzer manufacturer.

NOTE

Continue following steps only if monitor fails leakage check.

c. Remove instrument covers.

d. **CHECK**—All plug in circuit boards are pushed firmly into their mating receptacles.

e. **CHECK**—All cables are plugged firmly into their mating pins and that they are dressed away from ECG shield, input connector shield and pushbutton switch shafts.

f. **CHECK**—Screw and spacer securing ECG circuit boards are tight.

g. **CHECK**—Plastic board retainer is installed and properly seated at top of circuit boards.

h. Repeats steps a and b.

H. BATTERY CONDITIONER

H1. CHECK BATTERY CONDITIONER

a. Connect 413A to POWER LINE and turn on.

b. Push Battery Conditioner START button with a pencil point.

c. **CHECK**—Battery Conditioner START button does not light and 413A continues to operate.

d. Turn off 413A.

e. Push Battery Conditioner START button.

f. **CHECK**—Battery Conditioner START button lights.

g. Disconnect 413A power cord.

h. **CHECK**—Battery Conditioner START button light turns off.

H2. CONDITION BATTERY PACK

a. Connect 413A power cord to AC line and leave 413A turned off.

b. Push Battery Conditioner START button (button will light). Battery Conditioner circuitry is now functioning. To properly condition battery, 413A must be left connected to power line and not turned on for 12 hours. Battery Conditioner START light should go out sometime in first 4 hours. Actual time light stays on is dependent on charge in battery pack when conditioning cycle was started. battery pack is being discharged while light is on and recharged after light goes out.

MAINTENANCE

This section contains information which allows qualified service persons to perform preventive maintenance, troubleshooting, and corrective maintenance on the 413A Monitor.

PREVENTIVE MAINTENANCE

Preventive maintenance mainly consists of cleaning, visual inspection, and calibration. If performed on a routine basis, it can, many times, prevent major breakdowns. See Routine Maintenance Schedule below.

Preventive maintenance to be performed by an operator consists ONLY of external cleaning and external visual inspection of cables, plugs and wires (this includes a visual safety inspection). Operator maintenance instructions are given in the Operators Manual. That information is repeated here for convenient use by service personnel.

Preventive maintenance to be performed by a service person consists of external and internal cleaning, visual inspection, calibration and ECG patient-circuit leakage checks.

CLEANING

EXTERIOR

The recommended method of cleaning the exterior surfaces of the monitor is with a cloth or swab dampened with a warm water and mild soap solution. Do not permit liquids to run behind the knobs and pushbuttons or into the connectors.

INTERIOR

Cleaning the interior of the instrument should only be occasionally necessary. The best way to clean the interior is to blow off the accumulated dust with dry, low-velocity air (approximately 5 lb/in^2). Remove any dirt which remains with a soft brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for for cleaning in narrow spaces, or for cleaning more delicate circuit components.

VISUAL INSPECTION

EXTERNAL

Inspect all removable cables, wires, etc. Pay careful attention to the points that frequently bend, as the repeated flexing at these points eventually will cause breakage. Replace frayed or otherwise damaged cables.

Inspect the power cord and plug for damage. Repair or replacement should be performed only by qualified personnel.

CAUTION

Monitors that have been dropped or otherwise abused should be checked by qualified service personnel to verify all safety features.

INTERNAL

In addition to checking external cables and wires, service personnel should occasionally inspect the 413A interior. Check for such defects as broken connections, improperly seated semiconductors, damaged circuit boards, and heat-damaged parts.

The method for correcting most visible defects is obvious. However, be particularly careful if heat-damaged components are found because overheating usually indicates other trouble in the instrument. It is important to correct the cause of overheating to prevent recurrence of the damage.

CABINET REMOVAL

WARNING

Electric shock hazard exists when monitor is operated with covers removed. Avoid touching exposed connections or components which might be elevated from ground (e.g., some metal-cased transistors).

All ac line-voltage connections are covered and located on the rear panel. Some exposed voltages are, + and -35 V in the vertical amplifier circuit and -50 V, +165 V in DVM circuit, +175 V, and +3400 V in the crt circuit.

Disconnect monitor from ac power source and unplug battery plug (P1982) before cleaning interior of monitor or replacing components.

To remove the top cover, remove the two screws on each side, lift up the left side of the cover, then make sure it has cleared the ECG LEAD CHECK terminals and remove the cover from the monitor.

To remove the bottom cover, remove the two screws on each side and pull the cover straight off.

NOTE

Be sure board retainer clip is in place before replacing top cover. See Figure 5-1.

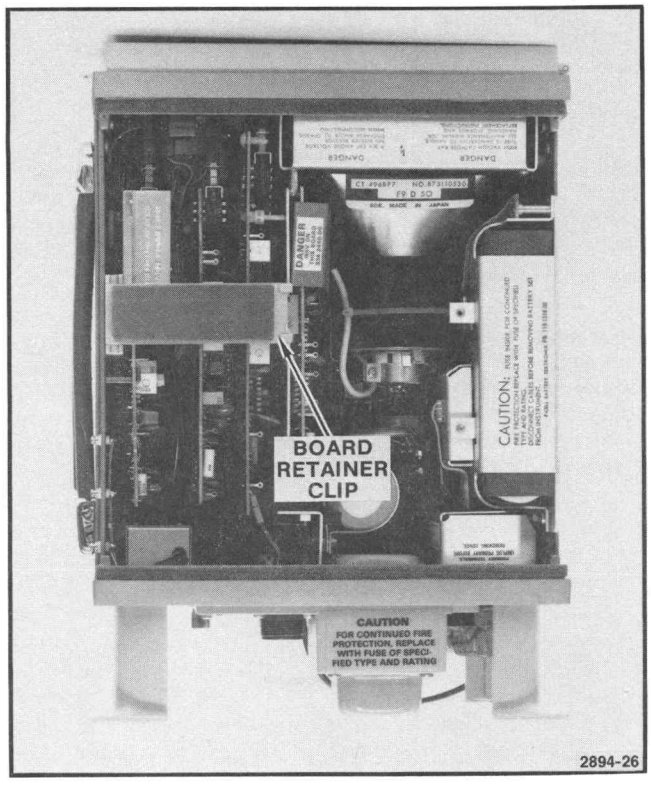


Fig. 5-1. Board retainer clip installation.

CALIBRATION

Monitor adjustment should be checked at least every 6 months or 1000 hours. Certain adjustments may be necessary following component replacement as indicated in the Component Replacement portion of this section. The adjustment procedure are located in section 4, Calibration.

ECG LEAKAGE CHECK

A leakage check should be made at least every six months or whenever the monitor has been dropped or otherwise abused. Also, check leakage after any repairs.

This check is to determine the amount of leakage current which could be present between the patient and the monitor under either of the following abnormal conditions: (1) monitor is properly grounded and patient is at 120 Vac, 60 Hz, or (2) monitor is not grounded, case is connected to 120 Vac, 60 Hz and patient is grounded.

TEST EQUIPMENT REQUIRED

Use an instrument such as the Model 431 Safety Analyzer, manufactured by Neutrodyne-Dempsey Inc., P.O. Box 1925, Carson City, Nevada.

LEAKAGE CHECK PROCEDURE

1. Disconnect monitor from ac power source.
2. Separate 400 and/or 401 from monitor. Do not disconnect interconnecting cables or wires.
3. CHECK—All plug-in circuit boards are pushed firmly into their mating receptacles.
4. CHECK—All cables are plugged firmly into their mating pins and that they are dressed away from ECG shield, input connector shield and pushbutton switch shafts.
5. CHECK—Screw and spacer securing ECG circuit board are tight.
6. CHECK—Plastic board retainer is installed and properly seated at top of circuit boards.
7. Replace 400 and/or 401 onto monitor and install top and bottom covers. Leakage check is valid only with covers installed.
8. Check ECG-leakage current using procedure supplied by the the Safety Analyzer manufacturer.

TROUBLESHOOTING AIDS

The following is provided to facilitate troubleshooting the 413A monitor. Information contained in other sections of this manual should be used in conjunction with the following data to aid in locating a defective component. An understanding of the circuit operation is also helpful. See Section 3, Theory of Operation, for this information.

SERVICING EXTENDER SET

Servicing Extender Set, Tektronix part 020-0291-00 is available to aid in troubleshooting and calibration. It provides an extender board and the cables necessary to operate the monitor with any of the plug-in circuit boards extended. Use of the Servicing extender set is essential to extend conditioner board when making main board adjustments.

SCHEMATIC DIAGRAMS

Complete schematic diagrams are given on the following pages in Section 8, Diagrams and Circuit Board Illustrations. The component number and electrical value of each component in this instrument are shown on these diagrams. (See the first page of the Diagrams and Circuit Board Illustrations section for definitions of the reference designators and symbols used to identify components in this instrument). Circuit-number locations are identified with a grid-index system. Important voltages and idealized waveforms are also shown on the diagrams. The portions of circuits mounted on circuit boards are enclosed with heavy solid black lines.

CIRCUIT BOARD ILLUSTRATIONS

A circuit board illustration is shown in conjunction with each circuit diagram. These are located on the back of the pull-out page opposite the associated circuit diagram. Each circuit component and waveform test point shown on the circuit diagram is identified on the circuit board illustration by its circuit number. Circuit number locations are identified with a grid-index system.

ADJUSTMENT AND TEST POINT LOCATIONS

To aid in locating test points and adjustable components called out in the Adjustment procedure, an Adjustment and Test Point Locations foldout page is provided in Section 8, Diagrams and Circuit Board Illustrations.

COMPONENT VALUE IDENTIFICATION

Values of capacitors, diodes, and resistors used in this instrument are identified by direct numerical values or by a color-code scheme. Figure 5-2 shows the color-code and numerical-value schemes used.

SEMICONDUCTOR LEAD CONFIGURATIONS

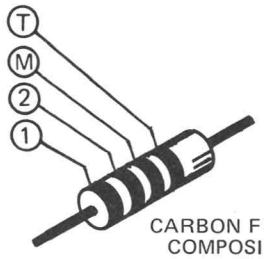
Typical semiconductor lead configurations are shown in Figure 5-3. Before handling semiconductors or boards containing semiconductors, see the special handling caution in this section under Component Removal and Replacement, Semionductors.

TRUTH TABLES

Truth tables are given on pullout pages in the Diagrams and Circuit Board Illustrations section of this manual. These truth tables give the logic state outputs for specified inputs to the various integrated circuits used in the 413A monitor.

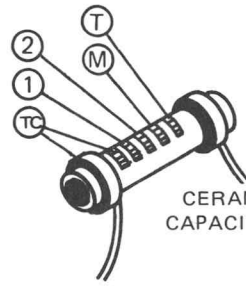
TYPICAL POWER SUPPLY VOLTAGES

Table 5-1 lists the output voltages and typical ripple of the 413A power supplies. These voltages are measured between the power supply test points and ground (see Adjustment and Test Point Locations pullout page in section 8, Diagrams and Circuit Board Illustrations for Test Point Locations).

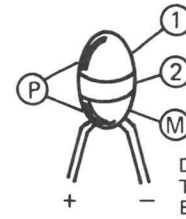


CARBON FILM & COMPOSITION RESISTORS

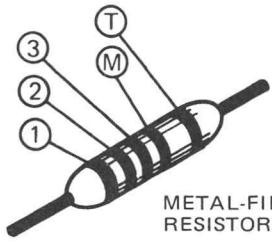
COLOR CODE



CERAMIC CAPACITORS



DIPPED TANTALUM ELECTROLYTICS



METAL-FILM RESISTORS

① ② and ③ - 1ST, 2ND, AND 3RD SIGNIFICANT FIGS. Ⓜ - MULTIPLIER Ⓣ - TOLERANCE; Ⓣ AND/OR Ⓣ COLOR CODE MAY NOT BE PRESENT ON SOME CAPACITORS; Ⓟ - POLARITY AND VOLTAGE RATING

Ⓣ - TEMPERATURE COEFFICIENT.

COLOR	SIGNIFICANT FIGURES	RESISTORS		CAPACITORS			DIPPED TANTALUM VOLTAGE RATING
		MULTIPLIER (OHMS)	TOLERANCE	MULTIPLIER (pF)	TOLERANCE		
					OVER 10pF	UNDER 10pF	
BLACK	0	1	---	1	±20%	± 2pF	4VDC
BROWN	1	10	±1%	10	±1%	±0.1pF	6VDC
RED	2	10^2 or 100	±2%	10^2or 100	±2%	---	10VDC
ORANGE	3	10^3or 1 K	±3%	10^3 or 1000	±3%	---	15VDC
YELLOW	4	10^4 or 10K	±4%	10^4 or 10,000	+100% –0%	---	20VDC
GREEN	5	10^5 or 100 K	±1/2%	10^5or 100,000	±5%	±0.5pF	25VDC
BLUE	6	10^6 or 1 M	±1/4%	10^6 or 1,000,000	---	---	35VDC
VIOLET	7	---	±1/10%	10^7 or 10,000,000	---	---	50VDC
GRAY	8	---	---	10^{-2} or 0.01	+80% –20%	±0.25pF	---
WHITE	9	---	---	10^{-1} or 0.1	±10%	±1pF	3VDC
GOLD	---	10^{-1} or 0.1	±5%	---	---	---	---
SILVER	---	10^{-2} or 0.01	±10%	---	---	---	---
NONE	---	---	±20%	---	±10%	±1pF	---

(1862-74) 2894-49

Fig. 5-2. Color-coded-component value identification.

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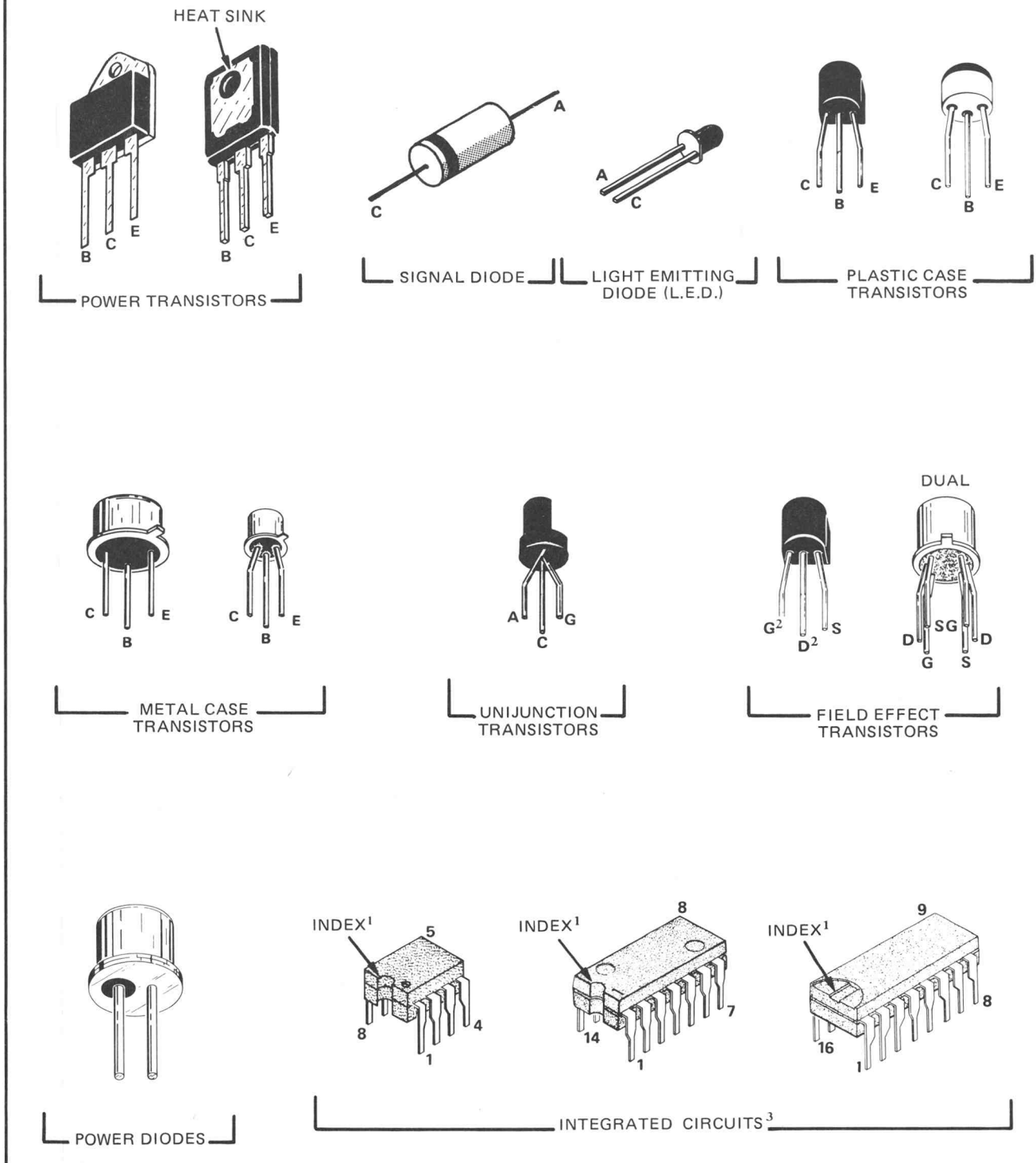

[1] Index configuration may vary from one IC to another.
[2] Gate and drain reversed for Q3087, Q3088, and Q4173.
[3] The 24-pin IC uses the same basic pin-numbering scheme as those shown.

(2277-35A) 2894-50

Fig. 5-3. Semiconductor lead configurations.

TABLE 5-1
Power Supply Voltages

POWER SUPPLY VOLTAGE	TEST POINT	TYPICAL VOLTAGE RANGE	TYPICAL RIPPLED (Peak-to-Peak)
2	TP2093	-11.9 to -12.1 V	100 mV
-12	TP4393	-11.9 to -12.1 V	100 mV
+7	TP2083	+6.8 to +7.2 V	75 mV
-7	TP4389	-6.8 to -7.2 V	75 mV
-7	TP4389	-6.8 to -7.2 V	75 mV
-35	Emitter Q1674	-37 to -42 V	0.5 V
+7	TP4383	+6.8 to +7.2 V	75 mv
-50 (HV BD)	Junction CR2163	-45 to -55 V	1.5 V
+12	TP4377	+11.5 to +12.5 V	100 mV
+175 (HV BD)	Junction CR2161	+170 to 180 V	0.7 V
-35	Emitter Q4137	-37 to -42 V	0.5 V
-90 (DVM BD)	TP1011	-85 to -95 V	1.3 V
+35	Emitter Q4128	+37 to +42 V	0.5 V
+75 (DVM BD)	TP1016	+70 to +80 V	2.5 V
-50 (HV BD)	Junction CR4463 and C4463	-45 to -55 V	1.5 V
0.6 VAC RMS	Pin 1 of Crt	0.54 to 0.66 Vac	
+175 (HV BD)	Junction CR4461 and C4461	+170 to 180 V RMS	0.7 V
+2.5 V Primary	TP1984	+2.45 to +2.55 V	
-90 (DVM BD)	TP3939	-85 to -95 V	1.3 V
+5 V (Secondary)	TP1994	Calibrated to +4.95 to +5.05 V	30 mV
+5 V (DVM BD)	TP3913		30 mV
+75 (DVM BD)	TP3937	+70 to +80 V	2.5 V
+165 (DVM BD)	TP3918	+160 to +170 V	7.5 V
+3400	CRT ANODE	+3200 to +3600 V[a]	
0.6 VAC RMS crt heater	Pin 1 of Crt socket	0.54 to 0.66 Vac RMS	
+2.5 V Primary Ref.	TP1984	+2.45 to +2.55 V	
+5 V Secondary Ref.	TP1994	Calibrated to Within 5 mV	

[a] Reads approximately 3200 V ±200 V when measured with 20 kΩ/V VOM.

CORRECTIVE MAINTENANCE

Corrective maintenance consists of component replacement and instrument repair. Special techniques required to replace components and assemblies in the monitor are given here.

SERVICE RECORDS

It is advisable to keep a detailed service record, since the Monitor and its accessories are involved with patient care and safety. Include information such as Monitor type and serial number, failure, symptoms, routine maintenance performed, and the date.

OBTAINING REPLACEMENT PARTS

STANDARD PARTS

All electrical and mechanical part replacements can be obtained through your local Tektronix Field Office or representative. However, many of the standard electronic components can be obtained locally in less time than is required to order from Tektronix, Inc. Before ordering or purchasing replacement parts, check the parts list for value, tolerance rating, and description.

NOTE

When selecting replacement parts, remember that the physical size and shape of a component may affect its performance in the instrument. All replacement parts should be direct replacement unless you know that a different component will not adversely affect instrument performance.

SPECIAL PARTS

Some components in the monitor are manufactured or selected by Tektronix, Inc. to meet specific performance requirements. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. Order all special parts directly from your local Tektronix Field Office or representative.

ORDERING PARTS

When ordering replacement parts from Tektronix, Inc., include the following information:

1. Instrument type.
2. Instrument serial number.
3. A description of the part (if electrical, include the circuit number).
4. Tektronix part number.

SOLDERING TECHNIQUES

WARNING

Disconnect the Monitor from the power source, turn the Monitor off and unplug the battery (P1982) before soldering.

Use ordinary 60/40 solder and a 15 watt pencil-type soldering iron for most soldering in this instrument. If higher wattage soldering irons are used to remove large surface components, be careful not to apply so much heat that the etched circuit wiring separates from the base material. Excessive heat can also cause serious damage to multi-layer circuit boards.

CAUTION

Several of the circuit boards in the 413A Monitor are multi-layer type boards with a conductive path laminated between the top and bottom board layers. All soldering on these boards should be done with extreme care to prevent breaking the connections to this center conductor. The following boards in the 413A Monitor are multi-layer: A32—Pressure/Pulse, A33—Conditioner, A38—Main.

COMPONENT REMOVAL AND REPLACEMENT

WARNING

Disconnect the monitor from the power source and unplug the battery plug (P4110) before disassembling instrument and replacing components.

BATTERY PACK

The battery pack consists of four F-size, 1.25 V, nickel-cadmium (NiCd) cells, which are mounted inside of a metal case and fastened to the left side rail with two #4-40 flat-head screws. The battery power plug (P4110) and battery conditioner plug (P4117 are connected to the main board.

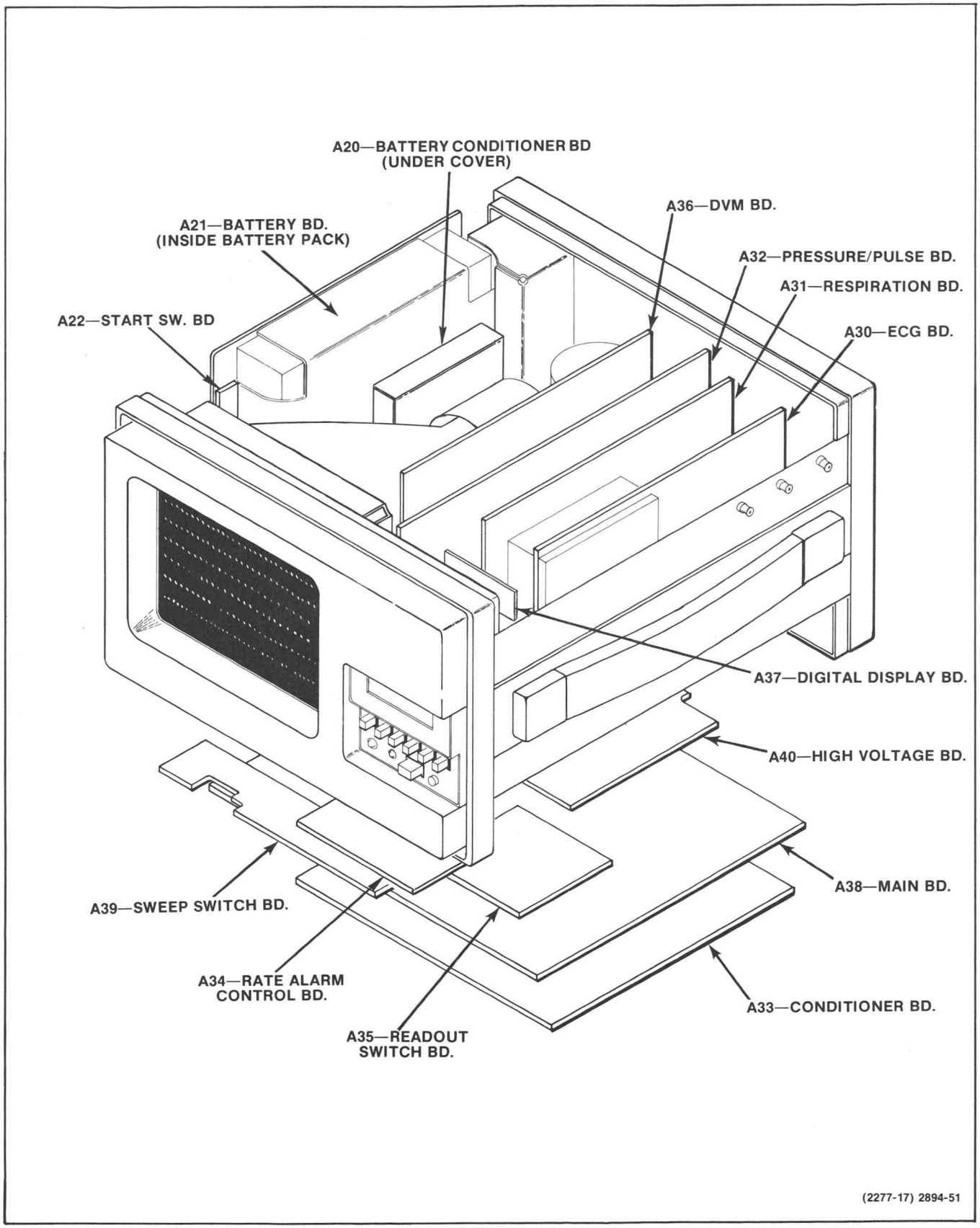

Fig. 5-4. Circuit-board locations.

CAUTION

The nickel-cadmium cells are capable of delivering a high current. Do not short circuit the cells, since this can cause the wire insulation to melt and the fuses to blow.

Battery Pack Disassembly

1. Unplug battery pack plug (P4110) and battery conditioner plug (P4117) from the Main board.

2. Unplug recorder battery-power plug (P5435) if recorder is attached.

NOTE

Do not replace individual cells unless the batteries are relatively new (e.g., less than one year). Replace cells only with the type specified. Other types may not function properly or may be a hazard to the monitor and personnel. Operating time and/or high temperature performance may be degraded.

Cells

Before replacing the cells, read the Battery Operation and Condition information in the Operating information section. Do not assume that batteries are defective without first having run a conditioning cycle.

Battery Fuses

Remove and disassemble battery pack. Carefully unsolder and replace defective fuses that are mounted on the circuit board soldered to the cells.

INSTRUMENT DISASSEMBLY

Use the exploded drawings at the rear of this manual as a guide for disassembly. Observe all cautions and warnings found in this section and on the instrument. Fig. 5-4 shows locations of circuit board assemblies.

PUSHBUTTONS

Pushbuttons are snapped onto shafts or extensions. They can be removed by pulling them straight off the switch shafts or extensions using pliers protected with cloth or tape. Install pushbuttons by pressing them onto the switch shafts or extensions.

PUSHBUTTON-EXTENSION SHAFTS

To remove extension shafts, insert a sharp pointed tool, such as a scriber, between end of switch shaft and extension shaft. Moving scriber back and forth will cause extension shaft to be released from the switch shaft. See Fig. 5-5.

To install extension shaft press it straight onto switch shaft until it snaps in place.

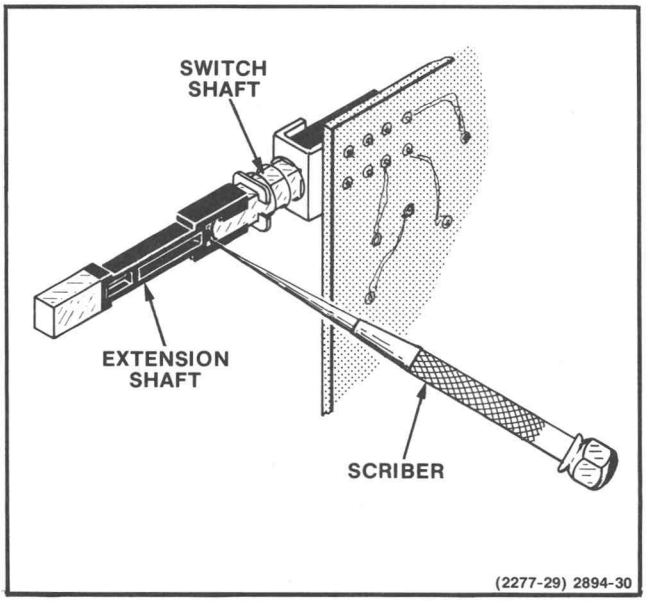

Fig. 5-5. Removing pushbutton extension shaft.

INTERCONNECTING CABLES AND TERMINAL CONNECTORS

Interconnecting cable assemblies used in the monitor consist of multiple-conductor cable with machine-installed terminal connectors, mounted in plastic holders.

The plastic holders, except on the battery cable, can be replaced easily. However, if the cable is defective, such as a wire broken loose from the terminal connector, it is often advisable to replace the complete cable assembly.

If the terminal connectors come loose from the plastic holder, they can be reinstalled as shown in Figure 5-6. When reinstalling connectors on board pins, be sure to match the triangle on the connector holder with the triangle on the circuit board for proper orientation.

SEMICONDUCTORS

CAUTION

To avoid component damage, turn off power before removing or replacing semiconductors. Also, semiconductors can be damaged by static discharge; see Recommended Handling Rules on page 5-18.

Semiconductors should not be replaced unless actually defective.

Unnecessary replacement of semiconductors may affect the adjustment of this instrument. When semiconductors are relaced, check the operation of that part of the instrument which may be affected.

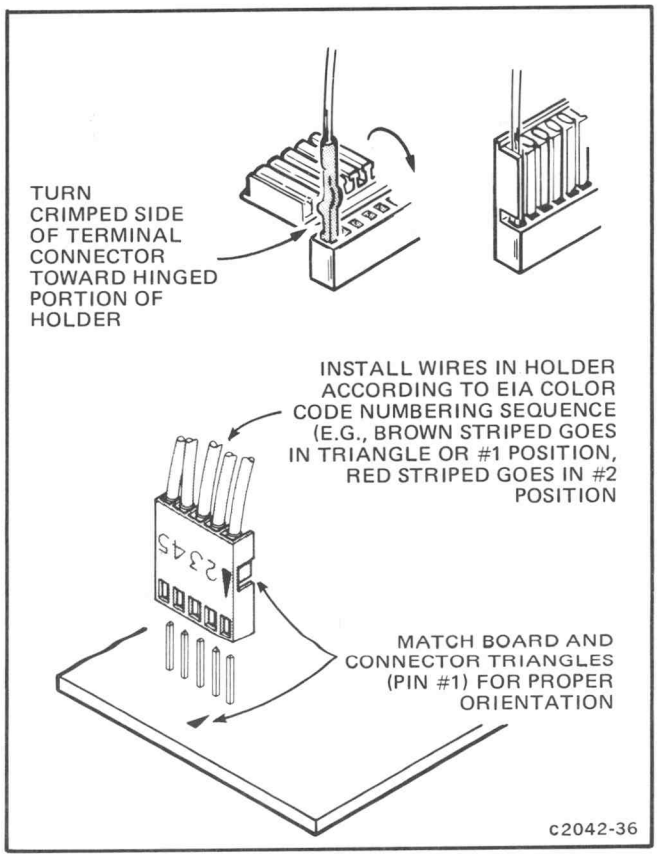

Fig. 5-6. Installation and orientation of terminal connectors.

Replacement devices should be of the original type or a direct replacement. Figure 5-3 shows the lead configurations of the semiconductor devices used in this instrument; when replacing, check the manufacturer's basing diagram for correct basing. Semiconductors that have heat radiators use silicone grease to increase heat transfer. Replace silicone grease when replacing these semiconductors.

WARNING

Handle silicone grease with care. Avoid getting the silicone grease in your eyes. Wash hands thoroughly after use.

An extracting tool should be used to remove integrated circuits to prevent damage to the pins. This tool is available from Tektronix, Inc. Order Tektronix part 003-0619-00. If an extracting tool is not available when removing one of these integrated circuits, pull slowly and evenly on both ends of the device. To prevent damage to the pins avoid having one end of the integrated circuit disengage from the socket before the other.

INTERCONNECTING CIRCUIT-BOARD PINS

A circuit-board pin replacement kit, including necessary tools, instructions, and replacement pins with attached spare ferrules, is available from Tektronix, Inc. Order Tektronix part 040-0542-00. Replacement of circuit-board pins on multi-layer boards is not recommended; refer such repairs to your local Tektronix Field Office or representative.

CAUTION

Replace circuit-board pins on multi-layer boards with extreme caution. See Soldering Techniques for identification of multi-layer boards in this instrument.

To replace a damaged pin, first disconnect any pin connectors. Then unsolder the damaged pin (see Soldering Techniques) and pull it out from the board with a pair of pliers, leaving the ferrule (Fig. 5-7) in the hole if possible. If the ferrule from the replacement pin and press the new pin into the hole in the circuit board. If the ferrule is removed with the damaged pin, clean out the hole using a solder-removing tool and a scriber. Then press the replacement pin, with attached spare ferrule, into the hole. Position the replacement pin in the same manner as the original pin had been. Solder the pin to the circuit board on each side of the circuit board. If the original pin was bent at an angle to mate with a connector, carefully bend the new pin to the same angle. Replace the pin connector.

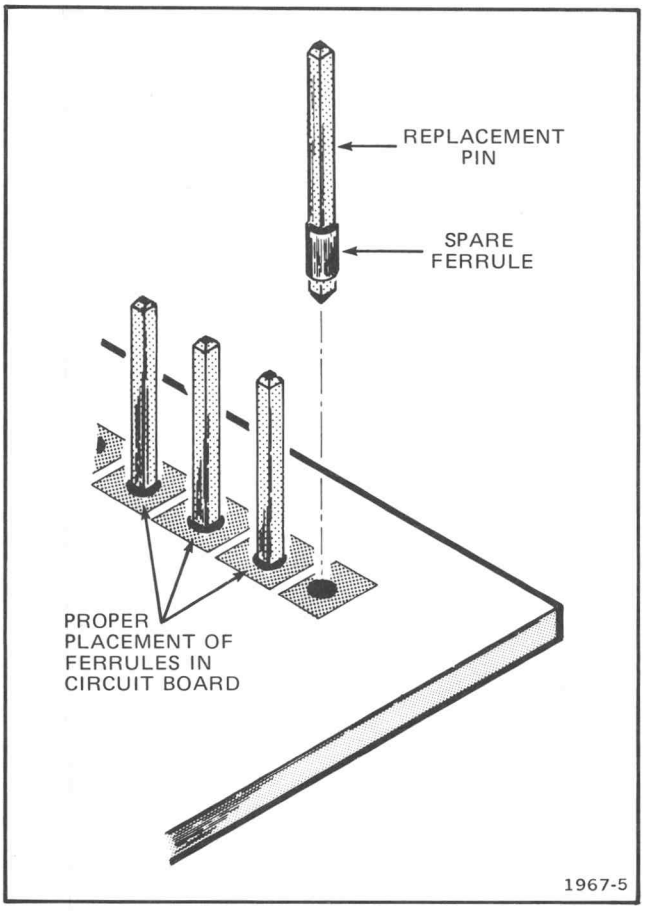

Fig. 5-7. View of typical circuit-board pin and ferrule.

FRONT PANEL

To remove front panel:

1. Remove amber plastic filter and black metal mask from readout housing. Use small-bladed screwdriver or small utility knife and carefully pry filter and mask out of readout housing.

2. Remove two screws holding readout housing to front panel. Remove housing.

3. Remove crt bezel and graticule (held with four screws).

4. Remove 8 knobs using 1/16 inch hex allen wrench.

5. Remove nuts and flat washers from the 8 potentiometers.

6. Pull front panel away from front subpanel.

To install front panel, reverse the above procedure observing the following precautions:

1. When replacing black metal mask make sure bumps on inside of mask opening are just above the HEART and TEMPERATURE A pushbuttons; if not, turn mask over.

2. Place concave side of amber filter toward readout devices. In this direction the readout elements are less visible.

3. Be sure to check alignment of knob indexes with front panel numbers. If unsure about where to align knob index marks, rotate the control from one extreme to the other and adjust knob on shaft so that index stops the same distance from the center bottom at each extreme. Check calibration of ECG, pulse, and rate limits functions with regard to front-panel knob settings.

FRONT ASSEMBLY

The front assembly can be removed as a single unit from the main instrument frame to replace components or make repairs.

To remove front assembly:

1. Carefully discharge anode connector to chassis.

2. Disconnect crt-anode connector. See Fig. 5-8 .

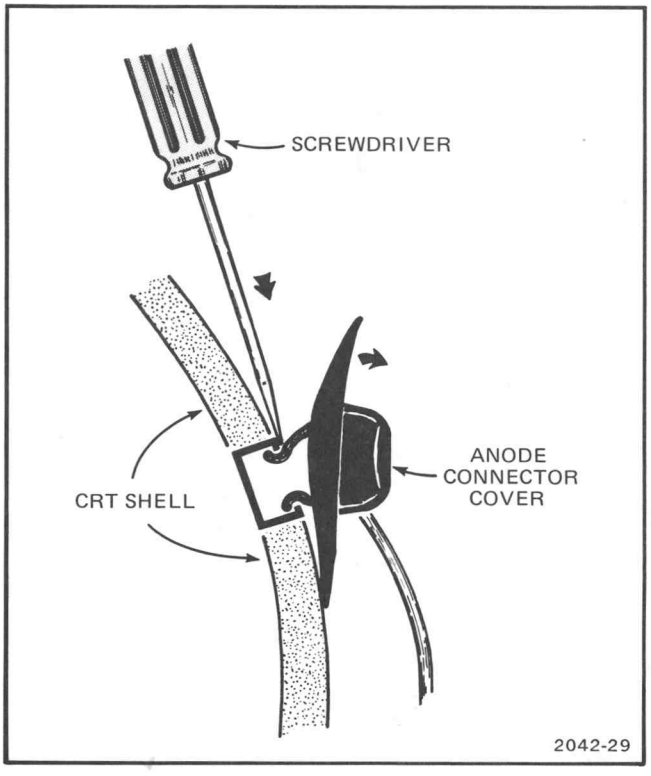

Fig. 5-8. Crt-anode connector removal and installation.

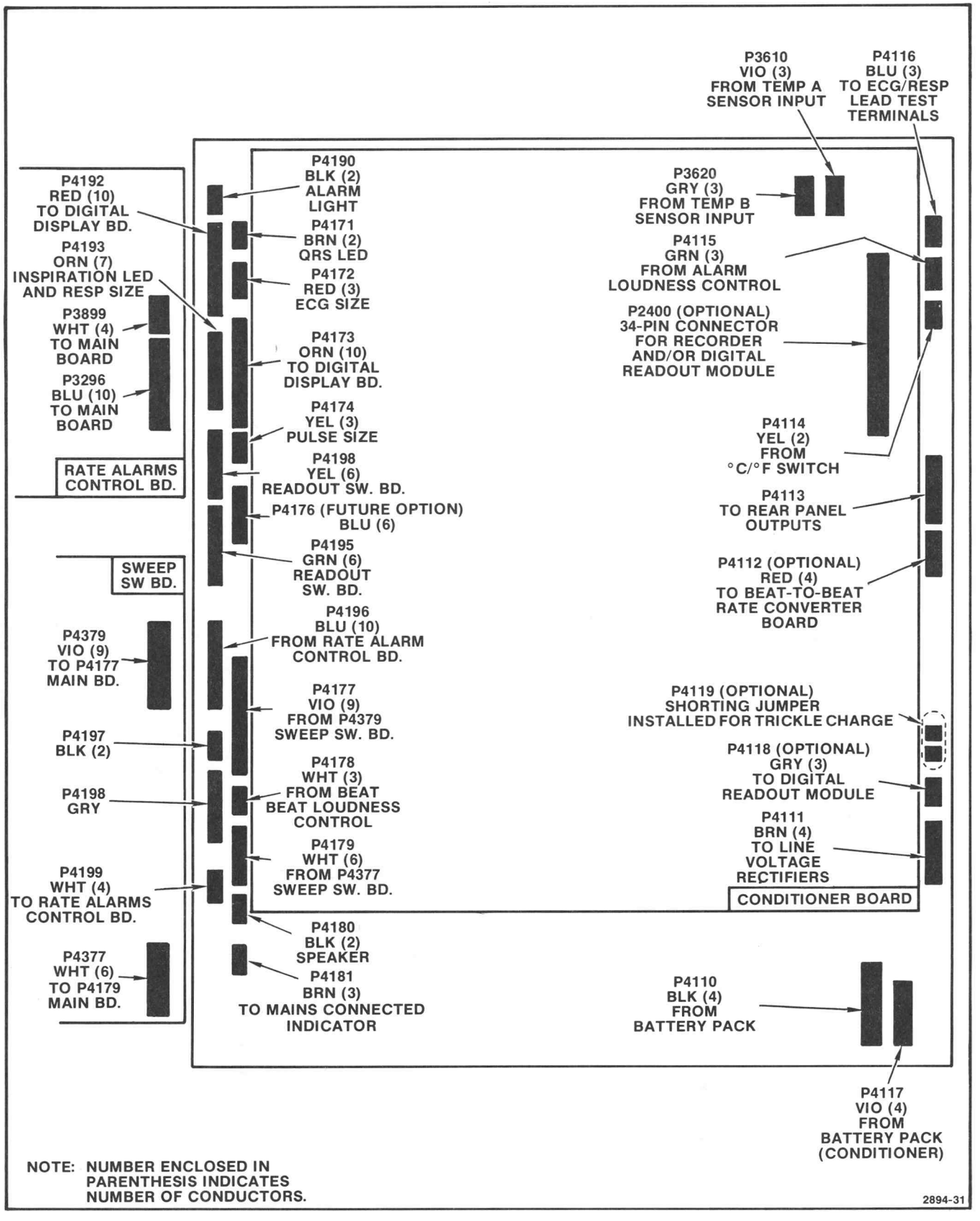

Fig. 5-9. Main and conditioner board cable connections.

3. Remove four nuts, one at each inside corner of front frame casting.

4. Unplug crt base plug from HV board and yoke plug from main board.

5. Disconnect all plugs along front edge of Main board and Conditioner board, except black two-wire speaker plug at crt end of the Main board.

6. Carefully pull the front panel away from the main frame casting.

To install front assembly:

1. Guide cables into front casting opening and set front assembly in place. Make sure cables are emerging toward the bottom of the instrument and do not get caught on the top of the Main board.

2. Set front assembly in place in front casting, guiding pushbuttons into the appropriate holes in the front panel.

3. Secure assembly with the four #4 nuts.

4. Connect crt-anode connector.

5. Connect crt base and yoke plugs (P2141 and P1690).

6. Connect cable plugs to Main board and Conditioner board as shown in Fig. 5-9.

CIRCUIT BOARDS

Occasionally a circuit board may be damaged beyond repair. If this is the case, replace the entire board assembly. Part numbers for completely wired boards are given in the Replaceable Electrical Parts list.

CAUTION

To prevent instrument damage when installing boards, be sure to properly align interconnecting pins and guide pins on Main board with receptacles on plug-in boards.

ECG Board

To remove board:

1. Remove board retainer clip (Fig. 5-1).

2. Remove screw holding board to right-hand rail.

3. Pull board straight away from Main board to unplug.

4. Tip board as necessary and remove from instrument.

5. Unplug P3255 (3-conductor plug) from Respiration board.

6. Remove screw from input circuit shield. Slide shield down cables.

7. Unplug both cable plugs from board.

8. If replacement board is to be installed, transfer pushbuttons and switch-shaft extensions to new board. See note below.

NOTE

Switch shaft extensions are easily broken during removal unless proper method is used. See paragraph on removal of pushbutton-extension shafts and Fig. 5-5.

To install board:

1. Connect ECG input cable plug (P3047) and respiration input cable plug (P3036) to board. Be sure to match triangles on plugs with those on board.

2. Install shield as shown in Fig. 5-10.

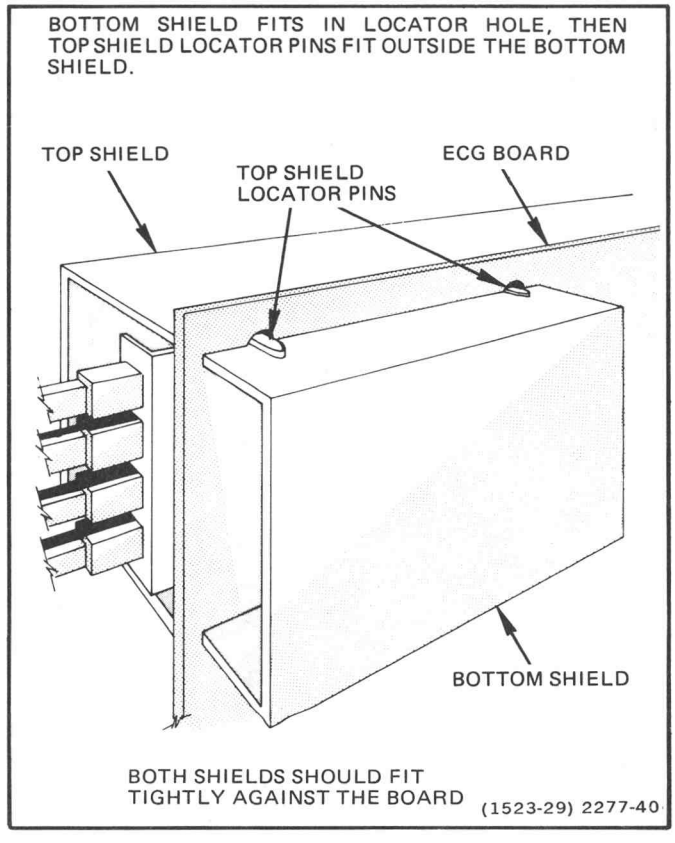

Fig. 5-10. ECG shield installation.

3. Connect respiration input plug (P3255) to Respiration board.

4. Plug ECG board onto interface pins on Main board. Tip board and insert pushbuttons into holes in front panel before plugging board onto interface pins.

5. Install board retaining screws through side rail.

6. Dress all cables away from circuit board shield, ECG input connector shield, and switch shafts.

7. Install board retainer clip. See Fig. 5-1.

8. Check calibration of ECG channel and check ECG patient-circuit leakage. Refer to Calibration section.

Respiration Board

To remove board:

1. Remove extension shaft from Respiration DISPLAY OFF switch shaft. See Fig. 5-5.

2. Pull Respiration board straight up to unplug from Main board.

3. Unplug respiration input cable plug (P3255).

To install board, reverse procedure.

Pressure/Pulse Board.

To remove board:

1. Unplug 2 cable plugs from rear of boards.

2. Pull board straight up to unplug. Lift rear of board higher than front to release front guide pin.

3. Remove board from instrument.

To install board:

1. Set board in place over interface pins without inserting pushbuttons through front panel.

2. Lift rear of board and insert pushbuttons into their respective holes in the front panel.

3. Lift up on front of board and align plastic guide pin on Main board with guide on Pressure/Pulse board. Align rear guide and pin and plug board onto interface pins.

4. Connect cable plugs to rear of board. The 6-conductor brown plug goes to the outside pins and the red plug goes to the inside pins.

DVM Board.

Pull board straight up to unplug.

To install board, position board assembly so that the metal shield is facing the Pressure/Pulse board, align plastic guides, and plug board onto interface pins. Make sure support pin on crt bracket fits between board and metal shield.

Conditioner Board.

To remove board:

1. Unplug 2 cables from board. If 400 or 401 is also attached, unplug 34-pin plug P2400.

2. Remove 3 screws and spacer screw holding Conditioner board to Main board.

3. Unplug 60-pin interface connector (P3600). Use a small screwdriver and pry between side rail and edge of board. Pry a little at a time along the length of connector until the pins are released from the plug.

4. Remove board and insulating sheet.

To install board:

1. Set insulating sheet in place over Main board components. When positioned properly, board mounting studs will show through holes in insulating sheet.

2. Align Conditioner board interface pins with sockets on Main board.

3. Press along length of connector a little at a time until all pins are seated firmly into their sockets.

4. Connect 4 plugs to Conditioner board: violet and gray.

Main Board.

To remove board:

1. Remove ECG, Respiration, Pressure/Pulse, and DVM boards.

2. Unplug crt base cable plug (P4400) and yoke plug (P4114).

3. Carefully discharge anode connector to chassis.

4. Disconnect crt-anode lead. See Fig. 5-8.

5. Remove Conditioner board.

6. Unplug all cable plugs from Main board.

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7. Remove 11 screws holding Main board brackets to side rails and rear panel.

8. Main board can now be removed from monitor.

To install board, reverse removal procedure. Refer to Fig. 5-9 for locations of cable plugs.

HV Board

To remove HV board, it is necessary to remove either the crt or the front assembly. The HV board is plugged onto the Main board.

Display Board.

To remove board:

1. Remove ECG board and Respiration board.

2. Unplug 2 interconnecting cables from Dsplay board.

3. Remove 2 mounting screws

4. Remove board from instrument.

To remove display devices from Display board:

Using a screw driver (preferably with plastic shaft), carefully pry readout device out of its scoket. Pry a little at each side until readout device is released from socket. Make sure pins are straight before attempting to install readout device.

To install board, reverse removal procedure. Then check ECG and Respiration adjustments and check ECG patient-circuit leakage. See Calibration section.

Readout Switch Board

To remove this board, it is necessary to remove the ECG and Respiration board, the front panel and the two screws through the front subpanel.

After replacing Readout Switch board, check those adjustments related to replacement of the ECG and Respiration board.

Sweep Switch Board

To remove this board, it is necessary to remove the front panel and the two screws through the front subpanel.

ZERO CONTROL

To remove zero control:

1. Remove Pressure/Pulse board.

2. Pull off ZERO control knob.

3. Remove mounting nut. Nut is recessed through the front panel. Insert the tips of a needle-nose pliers into the slots along the top edge of the nut and rotate counterclockwise.

4. Unplug P4194 from Main board and remove ZERO control assembly.

QRS AND INSPIRATION LED

NOTE

It is likely that the LED holder cap will be damaged when the LED is unsoldered. Therefore, it is a good idea to order a new holder cap with the new LED.

To replace either QRS or INSPRATION LED (light-emitting diode), proceed as follows: (Refer to Fig. 5-11).

1. Remove LED holder cap by pulling it off holder.

2. Unsolder wires from old holder cap.

3. Place LED leads into new holder cap. (The old cap will be almost impossible to salvage) Do not cut LED leads yet. Note that cathode lead is shorter.

4. Press new holder cap not holder.

5. Push on LED leads so that LED moves forward through front panel as far as it will go.

6. Cut short LED lead and solder white/red wire to holder cap terminal. The plastic cap melts quickly with excessive heat. Use 15 Watt or less iron for only 1 to 2 seconds.

7. Cut long LED lead and solder white/brown wire to holder cap terminal.

CRT

To replace the crt, proceed as follows:

WARNING

Handle the crt carefully. Rough handling or scratching increases the implosion hazard.

To remove crt:

1. Remove DVM Board.

2. Remove battery pack.

3. Carefully discharge anode connector to chassis.

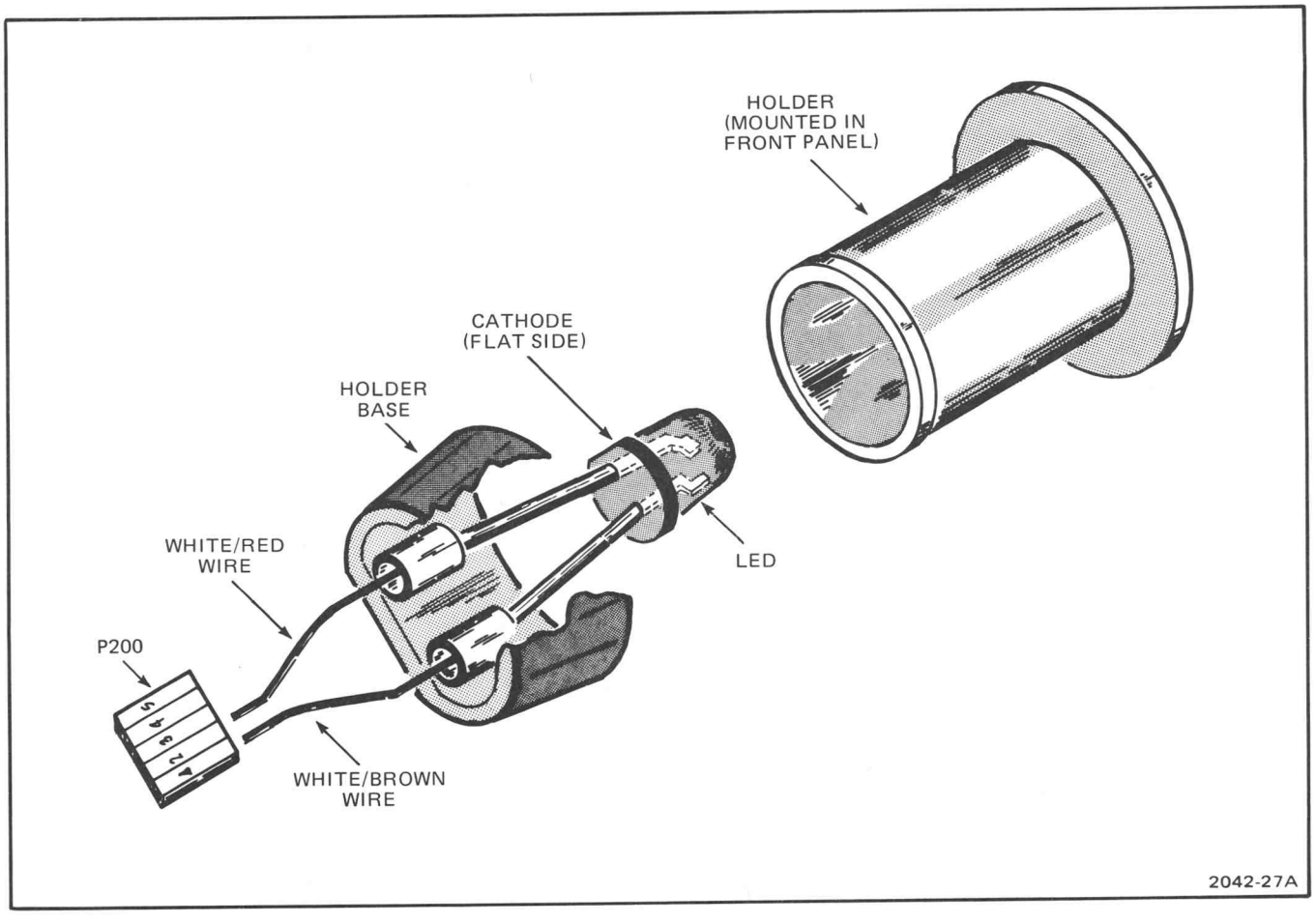


Fig. 5-11. QRS and INSPIRATION LED replacement.

4. Disconnect crt-anode connector as shown in Fig. 5-8.

5. Unplug crt base socket from crt and yoke plug from Main board.

6. Remove four nuts (one at each inside corner) holding complete front assembly.

7. Pull front assembly away from front frame casting just far enough to remove four long #4-40 screws holding crt retainer frame.

8. Pull crt and retainer away from front panel and remove from instrument.

To install crt:

1. Set crt and retainer in place against front subpanel. Make sure plastic corner pads are in place.

2. Secure crt retainer frame with four long #4-40 screws. Ears on crt retainer frame are to set into slots in front subpanel.

3. Set front-panel asembly in place and secure with four #4-40 nuts. Be careful not to pinch cable wire between front subpanel and front frame casting.

4. Reconnect crt base socket and yoke plug.

5. Reconnect crt anode connector. See fig 5-8.

6. Replace battery pack.

7. Replace DVM Board.

8. After replacing crt, check following adjustments (see Adjustments section): centering rings, crt yoke, Focus (R4440), Horizontal Position (R1835), Horizontal Width (R4126), Trace Zero (R3468), and Vertical Sensitivity (R4125).

ACCESSORY REPAIR

The following information should be considered when replacing or repairing accessories.

PRESSURE TRANSDUCERS

Pressure transducers are not considered field repairable. Repair or replacement should be done by the transducer manufacturer.

All non-differential transducers have a vent tube to atmospheric pressure. In many cases, this vent tube is within the transducer cable. Do not crush or kink this cable, because doing so could close the tube and prevent calibrated operation.

Transducer cable-end connectors frequently contain selected components and are often sealed with potting compound or epoxy, so that repair is difficult or impossible. Factory replacement of connectors by the transducer manufacturer may be the only practical alternative the original selected components may not be reusable and the factory is best equipped to reselect components

ECG CABLES

ECG cables are not considered repairable, except the tapped #4-40 connectors at the ends of the limb patient cable wires. The tapped individual electrode connectors can be repaired using a repair kit, Tektronix Part 040-0696-00.

Snap connectors should grip the electrode terminal firmly. If not, they often can be tightened by bending the contact inward gently with a scribe or small screwdriver.

CAUTION
STATIC ELECTRICITY DISCHARGE
CAN DAMAGE COMPONENTS

FACT: BOTH **MOS** AND **BIPOLAR** INTEGRATED CIRCUITS CAN BE DAMAGED BY DISCHARGE OF STATIC ELECTRICITY.

FACT: BOTH **DIGITAL** AND **LINEAR** I.C.'S CAN BE DAMAGED.

FACT: I.C.'S CAN BE DAMAGED WHEN THEY ARE **IN THE CIRCUIT** AS WELL AS WHEN THEY ARE NOT.

FACT: DAMAGE MAY **NOT** BE **APPARENT FOR SEVERAL MONTHS.**

RECOMMENDED HANDLING RULES

STORING AND TRANSPORTING

Don't *remove semiconductors or boards containing semiconductors from original antistatic container until needed.*

Don't *place semiconductors or boards containing semiconductors on or in plastic containers, styrofoam or other nonconductive material. Use material specifically treated for antistatic qualities.*

INSTALLING

Do *discharge static charge from your body. Connect yourself to ground through 100 kΩ while handling circuits or semiconductors.*

Do *use grounded soldering iron and test equipment.*

Do *turn the instrument power off before removing or inserting semiconductors.*

Do *use a grounded conductive bench top when working on boards or instruments containing semiconductors. If not available, use uncoated cardboard as a substitute.*

Don't *slide semiconductors or boards containing semiconductors across any surface.*

Don't *touch semiconductor leads unless necessary.*

OPTIONS

There were no options available for the 413A Monitor at the time of the first printing of this manual. When options become available, related information will be added behind the CHANGE INFORMATION tabbed page at the back of the manual.

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

LIST OF ASSEMBLIES

A list of assemblies can be found at the beginning of the Electrical Parts List. The assemblies are listed in numerical order. When the complete component number of a part is known, this list will identify the assembly in which the part is located.

CROSS INDEX-MFR. CODE NUMBER TO MANUFACTURER

The Mfr. Code Number to Manufacturer index for the Electrical Parts List is located immediately after this page. The Cross Index provides codes, names and addresses of manufacturers of components listed in the Electrical Parts List.

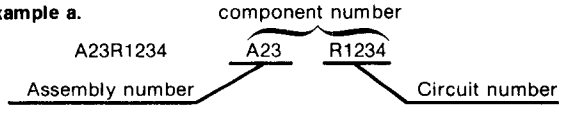
ABBREVIATIONS

Abbreviations conform to American National Standard Y1.1.

COMPONENT NUMBER (column one of the Electrical Parts List)

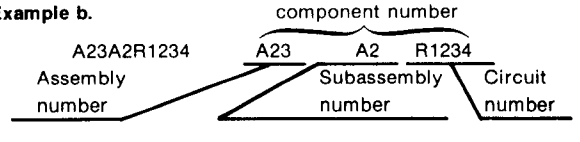
A numbering method has been used to identify assemblies, subassemblies and parts. Examples of this numbering method and typical expansions are illustrated by the following:

Example a.



Read: Resistor 1234 of Assembly 23

Example b.



Read: Resistor 1234 of Subassembly 2 of Assembly 23

Only the circuit number will appear on the diagrams and circuit board illustrations. Each diagram and circuit board illustration is clearly marked with the assembly number. Assembly numbers are also marked on the mechanical exploded views located in the Mechanical Parts List. The component number is obtained by adding the assembly number prefix to the circuit number.

The Electrical Parts List is divided and arranged by assemblies in numerical sequence (e.g., assembly A1 with its subassemblies and parts, precedes assembly A2 with its subassemblies and parts).

Chassis-mounted parts have no assembly number prefix and are located at the end of the Electrical Parts List.

TEKTRONIX PART NO. (column two of the Electrical Parts List)

Indicates part number to be used when ordering replacement part from Tektronix.

SERIAL/MODEL NO. (columns three and four of the Electrical Parts List)

Column three (3) indicates the serial number at which the part was first used. Column four (4) indicates the serial number at which the part was removed. No serial number entered indicates part is good for all serial numbers.

NAME & DESCRIPTION (column five of the Electrical Parts List)

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

MFR. CODE (column six of the Electrical Parts List)

Indicates the code number of the actual manufacturer of the part. (Code to name and address cross reference can be found immediately after this page.)

MFR. PART NUMBER (column seven of the Electrical Parts List)

Indicates actual manufacturers part number.

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
S0482	SONY CORPORATION		TOKYO, JAPAN
000FJ	MARCOM SWITCHES INC.	67 ALBANY STREET	CAZENOVIA, N.Y. 13035
000GU	SUPERTEX INC.	1225 BORDEAUX DRIVE	SUNNYVALE, CA 94086
00815	NORTHERN ENG. LABS, INC.	357 BELIOT	BURLINGTON, WISCONSIN 59105
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01002	GENERAL ELECTRIC COMPANY, INDUSTRIAL AND POWER CAPACITOR PRODUCTS DEPARTMENT	JOHN STREET	HUDSON FALLS, NY 12839
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
02111	SPECTROL ELECTRONICS CORPORATION	17070 EAST GALE AVENUE	CITY OF INDUSTRY, CA 91745
02660	BUNKER RAMO CORP., CONNECTOR DIVISION	2801 S 25TH AVENUE	BROADVIEW, IL 60153
02735	RCA CORPORATION, SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MYRTLE BEACH, SC 29577
04426	ILLINOIS TOOL WORKS, INC., LICON DIV.	6615 W IRVING PARK ROAD	CHICAGO, IL 60634
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
05464	INDUSTRIAL ELECTRONIC ENGINEERING, INC.	7720 LEMONA AVENUE	VAN NUYS, CA 91405
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
07716	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, BURLINGTON DIV.	2850 MT. PLEASANT	BURLINGTON, IA 52601
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
12969	UNITRODE CORPORATION	580 PLEASANT STREET	WATERTOWN, MA 02172
14099	SEMTECH CORP.	652 MITCHELL RD.	NEWBURY PARK, CA 91320
14433	ITT SEMICONDUCTORS	3301 ELECTRONICS WAY P O BOX 3049	WEST PALM BEACH, FL 33402
14752	ELECTRO CUBE INC.	1710 S. DEL MAR AVE.	SAN GABRIEL, CA 91776
16546	GLOBE UNION INC. USCC/CENTRALAB ELECTRONICS DIV.	4561 COLORADO	LOS ANGELES, CA 90039
19396	ILLINOIS TOOL WORKS, INC. PAKTRON DIV.	900 FOLLIN LANE, SE	VIENNA, VA 22180
24546	CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION	550 HIGH STREET	BRADFORD, PA 16701
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
50434	HEWLETT-PACKARD COMPANY	640 PAGE MILL ROAD	PALO ALTO, CA 94304
50522	MONSANTO CO., ELECTRONIC SPECIAL PRODUCTS	3400 HILLVIEW AVENUE	PALO ALTO, CA 94304
51984	NEC AMERICA INC. RADIO AND TRANSMISSION DIV.	2990 TELESTAR CT. SUITE 212	FALLS CHURCH, VA 22042
54426	BUSS SYSTEMS, INC.	140 CENTER STREET	EL SEGUNDO, CA 90245
55210	GETTIG ENG. AND MFG. COMPANY	PO BOX 85, OFF ROUTE 45	SPRING MILLS, PA 16875
56289	SPRAGUE ELECTRIC CO.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
81312	WINCHESTER ELECTRONICS DIVISION LITTON INDUSTRIES, INC.	MAIN ST. AND HILLSIDE AVE.	OAKVILLE, CT 06779
82389	SWITCHCRAFT, INC.	5555 N. ELSTON AVE.	CHICAGO, IL 60630
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
94696	MAGNECRAFT ELECTRIC COMPANY	5575 N LYNCH AVENUE	CHICAGO, IL 60630
99392	MEMPCO/ELECTRA INC., ROXBORO DIV.	P O BOX 1223	ROXBORO, NC 27573

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A20	670-6302-00			CKT BOARD ASSY:BATTERY CONDITIONING	80009	670-6302-00
A21	670-6303-00			CKT BOARD ASSY:FUSE INTERCONNECT	80009	670-6303-00
A22	670-6757-00			CKT BOARD ASSY:SWITCH	80009	670-6757-00
A30	670-6283-00			CKT BOARD ASSY:ECG	80009	670-6283-00
A31	670-6284-00			CKT BOARD ASSY:RESPIRATION	80009	670-6284-00
A32	670-6444-00			CKT BOARD ASSY:PRESSURE PULSE	80009	670-6444-00
A33	670-6282-00			CKT BOARD ASSY:CONDITIONER	80009	670-6282-00
A34	670-6280-00			CKT BOARD ASSY:RATE ALARM CONTROL	80009	670-6280-00
A35	670-6279-00			CKT BOARD ASSY:READOUT SWITCH	80009	670-6279-00
A36	670-6443-00			CKT BOARD ASSY:DVM	80009	670-6443-00
A37	670-6445-00			CKT BOARD ASSY:DIGITAL DISPLAY	80009	670-6445-00
A38	670-6281-00			CKT BOARD ASSY:MAIN	80009	670-6281-00
A39	670-6289-00			CKT BOARD ASSY:SWEEP SWITCH	80009	670-6289-00
A40	670-6756-00			CKT BOARD ASSY:HIGH VOLTAGE	80009	670-6756-00
A20	----- -----			CKT BOARD ASSY:BATTERY CONDITIONING		
A20C38	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A20C42	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A20C78	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A20CR35	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
A20CR53	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A20CR65	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A20CR67	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A20Q12	151-0621-00			TRANSISTOR:SILICON,NPN	80009	151-0621-00
A20Q13	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A20Q16	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A20Q17	151-0621-00			TRANSISTOR:SILICON,NPN	80009	151-0621-00
A20Q43	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A20Q46	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A20Q50	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A20Q58	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A20Q68	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A20R24	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
A20R26	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
A20R34	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A20R36	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A20R37	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
A20R42	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
A20R51	308-0499-00			RES.,FXD,WW:0.5 OHM,10%,2.5W AXIAL	91637	RS2B-ER5000K
A20R59	308-0499-00			RES.,FXD,WW:0.5 OHM,10%,2.5W AXIAL	91637	RS2B-ER5000K
A20R60	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A20R63	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
A20R64	301-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.50W	01121	EB3315
A20R65	308-0075-00			RES.,FXD,WW:100 OHM,5%,3W	91637	CW2B-100R0J
A20R67	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A20R70	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A20R73	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A20R83	303-0620-00			RES.,FXD,CMPSN:62 OHM,5%,1W	01121	GB6205
A20R87	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A21	----- -----			CKT BOARD ASSY:FUSE		
A21F1	159-0146-00			FUSE,CARTRIDGE:7A,32V,10 SECOND	54426	GFA7
A21F2A	159-0146-00			FUSE,CARTRIDGE:7A,32V,10 SECOND	54426	GFA7
A21F2B	159-0146-00			FUSE,CARTRIDGE:7A,32V,10 SECOND	54426	GFA7
A21F2C	159-0146-00			FUSE,CARTRIDGE:7A,32V,10 SECOND	54426	GFA7
A21F3	159-0146-00			FUSE,CARTRIDGE:7A,32V,10 SECOND	54426	GFA7
A22	----- -----			CKT BOARD ASSY:SWITCH		
A22S22	260-2041-00			SWITCH,PUSH:1 BTN,SPST,0.25A,30VAC	04426	39-12413

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A30	----- -----			CKT BOARD ASSY:ECG		
A30C3002	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
A30C3003	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
A30C3010	283-0128-00			CAP.,FXD,CER DI:100PF,5%,500V	72982	871-536T2H101J
A30C3015	283-0175-00			CAP.,FXD,CER DI:10PF,5%,200V	72982	8101B210C0G0100J
A30C3026	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
A30C3030	283-0128-00			CAP.,FXD,CER DI:100PF,5%,500V	72982	871-536T2H101J
A30C3031	283-0128-00			CAP.,FXD,CER DI:100PF,5%,500V	72982	871-536T2H101J
A30C3032	283-0594-00			CAP.,FXD,MICA D:0.001UF,1%,100V	00853	D151F102F0
A30C3033	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A30C3040	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A30C3042	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
A30C3043	283-0065-01			CAP.,FXD,CER DI:0.001UF,5%,100V	72982	0835582Z5E00102J
A30C3046	281-0814-00			CAP.,FXD,CER DI:100PF,10%,100V	04222	GC70-1-A101K
A30C3049	283-0028-00			CAP.,FXD,CER DI:0.0022UF,20%,50V	56289	19C606
A30C3054	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N075X7R0103M
A30C3055	283-0128-00			CAP.,FXD,CER DI:100PF,5%,500V	72982	871-536T2H101J
A30C3058	283-0339-00			CAP.,FXD,CER DI:0.22UF.10%,50V	72982	8131N075W5R224K
A30C3059	283-0100-00			CAP.,FXD,CER DI:0.0047UF,10%,200V	56289	273C3
A30C3071	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A30C3082	285-0598-00			CAP.,FXD,PLSTC:0.01UF,5%,100V	01002	61F10AC103
A30C3084	285-1076-00			CAP.,FXD,PLSTC:0.2UF,5%,100V	14752	230B1B204J
A30C3085	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A30C3086	281-0812-00			CAP.,FXD,CER DI:1000PF,10%,100V	72982	8035D9AADX7R102K
A30C3089	290-0523-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0020HA1
A30C3102	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
A30C3103	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
A30C3107	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	273C5
A30C3116	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A30C3118	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A30C3120	283-0339-00			CAP.,FXD,CER DI:0.22UF.10%,50V	72982	8131N075W5R224K
A30C3122	281-0852-00			CAP.,FXD,CER DI:1800PF,10%,100VDC	16546	C41A182K
A30C3123	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	273C5
A30C3124	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	273C5
A30C3129	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N075X7R0103M
A30C3130	283-0190-00			CAP.,FXD,CER DI:0.47UF,5%,50V	72982	8141N077X7R0474J
A30C3136	283-0268-00			CAP.,FXD,CER DI:0.015UF,10%,50V	72982	8121N083X7R0153K
A30C3138	283-0268-00			CAP.,FXD,CER DI:0.015UF,10%,50V	72982	8121N083X7R0153K
A30C3140	285-0809-00			CAP.,FXD,PLSTC:1UF,10%,50V	56289	LP66A1A105K
A30C3157	283-0341-00			CAP.,FXD,CER DI:0.047UF,10%,100V	72982	8121N153X7R0473K
A30C3175	283-0212-00			CAP.,FXD,CER DI:2UF,20%,50V	72982	8141N064Z5U205M
A30C3195	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A30C3196	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
A30C3198	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A30C3199	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
A30CR3006	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3007	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3008	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3009	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3022	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3061	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3062	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3066	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3067	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3068	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3069	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3071	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A30CR3086	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3107	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3109	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3110	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3116	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3132	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3151	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3152	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3165	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3167	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3172	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3177	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3179	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3183	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3184	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3196	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3199	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A30CR3014	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
A30CR3015	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
A30CR3034	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
A30CR3035	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
A30CR3118	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
A30DS3010	150-0173-00			LAMP,GLOW:LKG LESS THAN1 NA	08806	C2A-T
A30DS3030	150-0173-00			LAMP,GLOW:LKG LESS THAN1 NA	08806	C2A-T
A30DS3031	150-0173-00			LAMP,GLOW:LKG LESS THAN1 NA	08806	C2A-T
A30L3032	108-0888-00			COIL,RF:10MH	80009	108-0888-00
A30Q3000	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A30Q3001	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
A30Q3015	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A30Q3021	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A30Q3027	151-1049-00			TRANSISTOR:SILICON,JFE,N-CHANNEL,DUAL	80009	151-1049-00
A30Q3040	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A30Q3042	151-1004-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1004-00
A30Q3044	151-1004-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1004-00
A30Q3052	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A30Q3061	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
A30Q3074	151-0508-00			TRANSISTOR:UJT,SI,2N6027,TO-98	03508	2N6027
A30Q3083	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A30Q3085	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A30Q3087	151-1121-00			TRANSISTOR:FE,N CHANNEL,SI,VN-3	000GU	N01003N3
A30Q3088	151-1121-00			TRANSISTOR:FE,N CHANNEL,SI,VN-3	000GU	N01003N3
A30Q3095	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A30Q3096	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A30Q3098	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A30Q3099	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
A30R3003	311-1198-00			RES.,VAR,NONWIR:20K OHM,20%,0.5W	73138	72-29-0
A30R3004	311-1860-00			RES.,VAR,NONWIR:TRMR,10K OHM,0.50W	32997	3299X-R27-103
A30R3012	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A30R3014	314-0011-00			RES.,FXD,FILM:10G OHM,30%,0.5W	01121	EBH1093
A30R3015	321-0510-00			RES.,FXD,FILM:2M OHM,1%,0.125W	91637	HFF188G20003F
A30R3017	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
A30R3019	321-0378-00			RES.,FXD,FILM:84.5K OHM,1%,0.125W	91637	MFF1816G84501F
A30R3020	322-0222-00			RES.,FXD,FILM:2K OHM,1%,0.25W	75042	CEBT0-2001F
A30R3021	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A30R3022	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
A30R3024	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
A30R3026	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A30R3030	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A30R3032	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A30R3033	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A30R3034	314-0011-00			RES.,FXD,FILM:10G OHM,30%,0.5W	01121	EBH1093
A30R3035	321-0510-00			RES.,FXD,FILM:2M OHM,1%,0.125W	91637	HFF188G20003F
A30R3037	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
A30R3038	321-0378-00			RES.,FXD,FILM:84.5K OHM,1%,0.125W	91637	MFF1816G84501F
A30R3039	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
A30R3040	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
A30R3041	323-0085-00			RES.,FXD,FILM:75 OHM,1%,0.50W	91637	MFF1226G75R00F
A30R3043	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A30R3045	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A30R3047	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A30R3049	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A30R3051	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A30R3053	322-0193-00			RES.,FXD,FILM:1K OHM,1%,0.25W	75042	CEBT0-1001F
A30R3054	315-0163-00			RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
A30R3057	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A30R3058	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
A30R3059	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	24546	NA4D1004F
A30R3060	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A30R3061	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A30R3062	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A30R3064	311-1244-00			RES.,VAR,NONWIR:100 OHM,10%,0.50W	32997	3386X-T07-101
A30R3066	315-0164-00			RES.,FXD,CMPSN:160K OHM,5%,0.25W	01121	CB1645
A30R3067	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A30R3071	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A30R3072	315-0564-00			RES.,FXD,CMPSN:560K OHM,5%,0.25W	01121	CB5645
A30R3073	315-0364-00			RES.,FXD,CMPSN:360K OHM,5%,0.25W	01121	CB3645
A30R3077	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
A30R3078	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A30R3080	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A30R3082	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A30R3084	315-0684-00			RES.,FXD,CMPSN:680K OHM,5%,0.25W	01121	CB6845
A30R3086	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A30R3089	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A30R3090	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
A30R3091	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
A30R3095	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A30R3102	315-0163-00			RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
A30R3104	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A30R3105	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A30R3107	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A30R3109	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A30R3110	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
A30R3112	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A30R3113	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A30R3115	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
A30R3116	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
A30R3118	315-0106-00			RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
A30R3120	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A30R3122	315-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245
A30R3125	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
A30R3127	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
A30R3128	315-0113-00			RES.,FXD,CMPSN:11K OHM,5%,0.25W	01121	CB1135
A30R3129	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
A30R3130	315-0164-00			RES.,FXD,CMPSN:160K OHM,5%,0.25W	01121	CB1645

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A30R3132	315-0334-00			RES.,FXD,CMPSN:330K OHM,5%,0.25W	01121	CB3345
A30R3134	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
A30R3136	321-0274-00			RES.,FXD,FILM:6.98K OHM,1%,0.125W	91637	MFF1816G69800F
A30R3137	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	91637	MFF1816G30100F
A30R3139	321-0327-00			RES.,FXD,FILM:24.9K OHM,1%,0.125W	91637	MFF1816G24901F
A30R3140	315-0824-00			RES.,FXD,CMPSN:820K OHM,5%,0.25W	01121	CB8245
A30R3141	315-0514-00			RES.,FXD,CMPSN:510K OHM,5%,0.25W	01121	CB5145
A30R3143	321-0194-00			RES.,FXD,FILM:1.02K OHM,1%,0.125W	91637	MFF1816G10200F
A30R3144	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A30R3150	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
A30R3151	315-0433-00			RES.,FXD,CMPSN:43K OHM,5%,0.25W	01121	CB4335
A30R3154	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
A30R3156	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A30R3157	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
A30R3158	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A30R3159	315-0910-00			RES.,FXD,CMPSN:91 OHM,5%,0.25W	01121	CB9105
A30R3160	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A30R3161	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A30R3163	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A30R3165	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
A30R3167	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A30R3170	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
A30R3171	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A30R3172	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
A30R3174	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
A30R3177	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
A30R3178	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A30R3179	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A30R3181	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
A30R3195	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A30R3197	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
A30R3198	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
A30S3000	260-1213-02			SWITCH,PUSH:4 BUTTON,2 POLE,LEAD SEL	80009	260-1213-02
A30T3000	120-1126-00			TRANSFORMER,RF:SIGNAL INPUT,POT CORE	80009	120-1126-00
A30T3100	120-0947-00			XFMR,SIGNAL:POT CORE	80009	120-0947-00
A30TP3002	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A30TP3004	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A30TP3012	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A30TP3016	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A30TP3020	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A30TP3021	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A30TP3040	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A30TP3091	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A30TP3097	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A30U3012	156-0495-02			MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
A30U3020	156-0402-03			MICROCIRCUIT,LI:TIMER,TESTED	80009	156-0402-03
A30U3026	156-0158-03			MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
A30U3033	156-1291-00			MICROCIRCUIT,LI:OPERATIONAL AMPL,JFET INPUT	01295	TL062CP/PEP 3
A30U3036	156-0912-01			MICROCIRCUIT,LI:OPNL AMPL,SCREENED	02735	CA3080EX
A30U3071	156-0495-02			MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
A30U3075	156-0158-03			MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
A30U3077	156-1225-01			MICROCIRCUIT,LI:DUAL COMPARATOR,SCREENED	27014	LM393N/AT
A30U3089	156-0853-02			MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	04713	MLM358U
A30VR3001	152-0147-00			SEMICOND DEVICE:ZENER,0.4W,27V,5%	04713	SZ50622KRL
A30VR3020	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZ11755
A30VR3021	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZ11755
A30VR3067	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZ11755

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A31	----- -----			CKT BOARD ASSY:RESPIRATION		
A31C3201	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A31C3202	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A31C3203	283-0065-00			CAP.,FXD,CER DI:0.001UF,5%,100V	72982	805-518-Z5D0102J
A31C3204	283-0065-00			CAP.,FXD,CER DI:0.001UF,5%,100V	72982	805-518-Z5D0102J
A31C3208	283-0060-00			CAP.,FXD,CER DI:100PF,5%,200V	72982	855-535U2J101J
A31C3212	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A31C3223	283-0239-00			CAP.,FXD,CER DI:0.022UF,10%,50V	72982	8121N083X7R0223K
A31C3224	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A31C3227	283-0239-00			CAP.,FXD,CER DI:0.022UF,10%,50V	72982	8121N083X7R0223K
A31C3232	290-0527-01			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	196D156X0020K
A31C3237	290-0830-00			CAP.,FXD,ELCTLT:10 UF,5%,20V	56289	150D106X5020BZ
A31C3239	290-0244-00			CAP.,FXD,ELCTLT:0.47UF,5%,35V	56289	162D474X5035BC2
A31C3240	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N075X7R0103M
A31C3250	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A31C3251	283-0060-00			CAP.,FXD,CER DI:100PF,5%,200V	72982	855-535U2J101J
A31C3252	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
A31C3253	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
A31C3255	283-0060-00			CAP.,FXD,CER DI:100PF,5%,200V	72982	855-535U2J101J
A31C3257	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N145X5R0104K
A31C3278	285-1076-00			CAP.,FXD,PLSTC:0.2UF,5%,100V	14752	230B1B204J
A31C3282	285-1076-00			CAP.,FXD,PLSTC:0.2UF,5%,100V	14752	230B1B204J
A31C3283	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A31C3286	281-0812-00			CAP.,FXD,CER DI:1000PF,10%,100V	72982	8035D9AADX7R102K
A31C3287	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A31C3290	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A31C3291	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A31C3292	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
A31C3297	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A31C3298	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
A31C3310	285-1096-00			CAP.,FXD,PLSTC:1UF,10%,50V	14752	230B1B105K
A31C3312	283-0060-00			CAP.,FXD,CER DI:100PF,5%,200V	72982	855-535U2J101J
A31C3313	285-1096-00			CAP.,FXD,PLSTC:1UF,10%,50V	14752	230B1B105K
A31C3321	290-0726-01			CAP.,FXD,ELCTLT:220UF,20%,10V	51984	NDM227M10C
A31C3322	290-0726-01			CAP.,FXD,ELCTLT:220UF,20%,10V	51984	NDM227M10C
A31C3327	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	273C5
A31C3343	290-0719-01			CAP.,FXD,ELCTLT:47UF,20%,25V	80009	290-0719-01
A31C3345	290-0721-01			CAP.,FXD,ELCTLT:100UF,20%,20V	56289	196D107X0020T
A31C3357	283-0212-00			CAP.,FXD,CER DI:2UF,20%,50V	72982	8141N064Z5U205M
A31C3368	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A31C3370	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A31C3382	283-0341-00			CAP.,FXD,CER DI:0.047UF,10%,100V	72982	8121N153X7R0473K
A31CR3200	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3201	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3209	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3210	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3243	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3244	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3246	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3247	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3248	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3260	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3261	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3263	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3266	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3267	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3268	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A31CR3272	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3284	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3286	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3292	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3298	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3326	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3327	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3329	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3343	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
A31CR3345	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3348	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3357	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3361	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3362	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3363	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3372	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31CR3378	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A31Q3201	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A31Q3202	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A31Q3210	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A31Q3212	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A31Q3213	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A31Q3220	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A31Q3230	151-1004-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1004-00
A31Q3241	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A31Q3263	151-1004-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1004-00
A31Q3267	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A31Q3273	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A31Q3274	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A31Q3275	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A31Q3276	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A31Q3284	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
A31R3200	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A31R3201	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
A31R3202	315-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245
A31R3203	311-1860-00			RES.,VAR,NONWIR:TRMR,10K OHM,0.50W	32997	3299X-R27-103
A31R3204	315-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245
A31R3205	311-1198-00			RES.,VAR,NONWIR:20K OHM,20%,0.5W	73138	72-29-0
A31R3206	311-1248-00			RES.,VAR,NONWIR:500 OHM,10%,0.50W	73138	72-23-0
A31R3207	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A31R3208	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
A31R3210	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A31R3212	321-0297-00			RES.,FXD,FILM:12.1K OHM,1%,0.125W	91637	MFF1816G12101F
A31R3213	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	MFF1816G499R0F
A31R3214	321-0160-00			RES.,FXD,FILM:453 OHM,1%,0.125W	91637	MFF1816G453R0F
A31R3215	321-0160-00			RES.,FXD,FILM:453 OHM,1%,0.125W	91637	MFF1816G453R0F
A31R3216	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	91637	MFF1816G60400F
A31R3218	321-0257-00			RES.,FXD,FILM:4.64K OHM,1%,0.125W	91637	MFF1816G46400F
A31R3219	321-0257-00			RES.,FXD,FILM:4.64K OHM,1%,0.125W	91637	MFF1816G46400F
A31R3223	321-0395-00			RES.,FXD,FILM:127K OHM,1%,0.125W	91637	MFF1816G12702F
A31R3224	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
A31R3225	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
A31R3227	321-0395-00			RES.,FXD,FILM:127K OHM,1%,0.125W	91637	MFF1816G12702F
A31R3230	315-0394-00			RES.,FXD,CMPSN:390K OHM,5%,0.25W	01121	CB3945
A31R3231	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
A31R3233	315-0103-00	XB010402		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A31R3234	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A31R3237	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
A31R3239	321-0458-00			RES.,FXD,FILM:576K OHM,1%,0.125W	91637	MFF1816G57602F
A31R3240	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A31R3241	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
A31R3242	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A31R3243	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
A31R3244	315-0564-00			RES.,FXD,CMPSN:560K OHM,5%,0.25W	01121	CB5645
A31R3245	315-0514-00			RES.,FXD,CMPSN:510K OHM,5%,0.25W	01121	CB5145
A31R3248	315-0244-00			RES.,FXD,CMPSN:240K OHM,5%,0.25W	01121	CB2445
A31R3250	315-0163-00			RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
A31R3253	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
A31R3255	315-0514-00			RES.,FXD,CMPSN:510K OHM,5%,0.25W	01121	CB5145
A31R3257	315-0514-00			RES.,FXD,CMPSN:510K OHM,5%,0.25W	01121	CB5145
A31R3259	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A31R3260	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
A31R3261	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A31R3262	315-0103-00	B010100	C010218	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A31R3262	315-0104-00	C010219		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A31R3263	315-0104-00	B010100	C010218	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A31R3263	315-0105-00	C010219		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A31R3264	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
A31R3265	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
A31R3268	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
A31R3269	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A31R3271	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A31R3272	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
A31R3274	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A31R3275	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A31R3277	315-0184-00			RES.,FXD,CMPSN:180K OHM,5%,0.25W	01121	CB1845
A31R3278	315-0135-00			RES.,FXD,CMPSN:1.3M OHM,5%,0.25W	01121	CB1355
A31R3280	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
A31R3281	315-0684-00			RES.,FXD,CMPSN:680K OHM,5%,0.25W	01121	CB6845
A31R3284	315-0564-00			RES.,FXD,CMPSN:560K OHM,5%,0.25W	01121	CB5645
A31R3286	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A31R3287	315-0474-00	B010100	C010218	RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
A31R3287	315-0474-00	C010219		RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
A31R3290	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
A31R3291	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A31R3296	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
A31R3297	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
A31R3301	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A31R3303	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A31R3305	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A31R3306	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
A31R3307	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
A31R3309	321-0280-00			RES.,FXD,FILM:8.06K OHM,1%,0.125W	91637	MFF1816G80600F
A31R3310	321-0222-07			RES.,FXD,FILM:2K OHM,0.1%,0.125W	91637	MFF1816C20000B
A31R3312	315-0155-00			RES.,FXD,CMPSN:1.5M OHM,5%,0.25W	01121	CB1555
A31R3313	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	MFF1816G30101F
A31R3315	321-0194-00			RES.,FXD,FILM:1.02K OHM,1%,0.125W	91637	MFF1816G10200F
A31R3316	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A31R3321	315-0163-00			RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
A31R3323	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A31R3324	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A31R3326	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A31R3327	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A31R3329	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A31R3331	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A31R3333	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A31R3335	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
A31R3336	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
A31R3337	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
A31R3343	315-0106-00			RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
A31R3347	315-0164-00			RES.,FXD,CMPSN:160K OHM,5%,0.25W	01121	CB1645
A31R3348	315-0334-00			RES.,FXD,CMPSN:330K OHM,5%,0.25W	01121	CB3345
A31R3350	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
A31R3353	315-0155-00			RES.,FXD,CMPSN:1.5M OHM,5%,0.25W	01121	CB1555
A31R3354	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A31R3356	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A31R3357	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
A31R3359	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
A31R3361	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A31R3362	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
A31R3363	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A31R3366	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
A31R3368	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A31R3370	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
A31R3372	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
A31R3373	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A31R3375	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A31R3377	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A31R3380	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
A31R3382	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
A31S3200	260-1771-00			SWITCH,PUSH:DPDT,1 BUTTON,2 POLE	80009	260-1771-00
A31T3200	120-1127-00			TRANSFORMER,RF:ISOLATION,POTCORE	80009	120-1127-00
A31TP3207	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A31TP3210	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A31TP3212	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A31TP3218	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A31TP3221	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A31TP3222	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A31TP3225	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A31TP3229	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A31TP3232	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A31TP3240	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A31TP3254	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A31TP3259	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A31TP3260	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A31TP3278	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A31U3211	156-0402-03			MICROCIRCUIT,LI:TIMER,TESTED	80009	156-0402-03
A31U3224	156-0495-02			MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
A31U3226	156-0912-01			MICROCIRCUIT,LI:OPNL AMPL,SCREENED	02735	CA3080EX
A31U3227	156-1152-01			MICROCIRCUIT,DI:PRCN RETRIGGERABLE,BURN-IN	80009	156-1152-01
A31U3228	156-1191-01			MICROCIRCUIT,LI:DUAL BI-FET OP-AMP,8 DIP	01295	TL072CP
A31U3234	156-1291-00			MICROCIRCUIT,LI:OPERATIONAL AMPL,JFET INPUT	01295	TL062CP/PEP 3
A31U3235	156-1349-01			MICROCIRCUIT,LI:DUAL INDEP DIFF AMPL,SCRN	02735	CA3054S/5
A31U3241	156-0158-07			MICROCIRCUIT,LI:DUAL OPNL AMPL,SCREENED	04713	MC1458UDS
A31U3257	156-0801-01			MICROCIRCUIT,DI:DUAL 4-BIT STATIC SR,SCRN	04713	MC14015BCLD
A31U3262	156-0495-02			MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
A31U3271	156-0513-02			MICROCIRCUIT,DI:8-CHANNEL MUX,SEL	80009	156-0513-02
A31U3274	156-0853-02			MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	04713	MLM358U
A31U3278	156-0961-02			MICROCIRCUIT,DI:QUAD 2-INP NAND ST,BURN-IN	80009	156-0961-02
A31VR3262	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZ11755

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A32	----- -----			CKT BOARD ASSY:PRESSURE PULSE		
A32C3402	285-1069-00			CAP.,FXD,PLSTC:0.047UF,200V	14752	C2319
A32C3408	290-0441-00			CAP.,FXD,ELCTLT:20UF,10%,10V	56289	109D206X9010C2
A32C3409	281-0791-00			CAP.,FXD,CER DI:270PF,10%,100V	72982	8035D2AADX5R271K
A32C3415	281-0814-00			CAP.,FXD,CER DI:100PF,10%,100V	04222	GC70-1-A101K
A32C3416	290-0719-01			CAP.,FXD,ELCTLT:47UF,20%,25V	80009	290-0719-01
A32C3418	285-1069-00			CAP.,FXD,PLSTC:0.047UF,200V	14752	C2319
A32C3421	285-1069-00			CAP.,FXD,PLSTC:0.047UF,200V	14752	C2319
A32C3434	285-1101-00			CAP.,FXD,PLSTC:0.022UF,10%,200V	19396	223K02PT485
A32C3474	290-0721-01			CAP.,FXD,ELCTLT:100UF,20%,20V	56289	196D107X0020T
A32C3491	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A32C3492	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A32C3494	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A32C3506	290-0721-01			CAP.,FXD,ELCTLT:100UF,20%,20V	56289	196D107X0020T
A32C3508	281-0814-00			CAP.,FXD,CER DI:100PF,10%,100V	04222	GC70-1-A101K
A32C3513	290-0527-01			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	196D156X0020K
A32C3518	281-0814-00			CAP.,FXD,CER DI:100PF,10%,100V	04222	GC70-1-A101K
A32C3522	290-0721-01			CAP.,FXD,ELCTLT:100UF,20%,20V	56289	196D107X0020T
A32C3528	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
A32C3530	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N145X5R0104K
A32C3532	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
A32C3534	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N145X5R0104K
A32C3551	281-0814-00			CAP.,FXD,CER DI:100PF,10%,100V	04222	GC70-1-A101K
A32C3556	281-0809-00			CAP.,FXD,CER DI:200PF,5%,100V	72982	8013T2ADDC1G201J
A32C3557	283-0194-00			CAP.,FXD,CER DI:4.7UF,20%,50V	72982	8151N057Z5U0475M
A32C3566	283-0339-00			CAP.,FXD,CER DI:0.22UF.10%,50V	72982	8131N075W5R224K
A32C3567	281-0814-00			CAP.,FXD,CER DI:100PF,10%,100V	04222	GC70-1-A101K
A32C3569	281-0809-00			CAP.,FXD,CER DI:200PF,5%,100V	72982	8013T2ADDC1G201J
A32C3578	281-0814-00			CAP.,FXD,CER DI:100PF,10%,100V	04222	GC70-1-A101K
A32C3581	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N031Z5U0105Z
A32C3584	285-1069-00			CAP.,FXD,PLSTC:0.047UF,200V	14752	C2319
A32C3585	285-1189-00			CAP.,FXD,MTLZD:0.1UF,5%,100V	99392	C280MAH/J100K
A32C3586	285-1189-00			CAP.,FXD,MTLZD:0.1UF,5%,100V	99392	C280MAH/J100K
A32CR3401	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3402	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3404	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3406	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3410	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3416	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
A32CR3426	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
A32CR3427	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
A32CR3428	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3429	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3436	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3441	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3450	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3452	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3453	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3454	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3460	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3461	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3470	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3471	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3474	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3484	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3487	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3488	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A32CR3501	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3502	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3506	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3508	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3509	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3518	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3519	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3520	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3521	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3525	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3553	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3554	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3562	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3563	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3567	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32CR3568	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A32Q3443	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A32Q3444	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A32Q3451	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A32Q3461	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A32R3401	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
A32R3403	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
A32R3405	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
A32R3407	315-0560-00			RES.,FXD,CMPSN:56 OHM,5%,0.25W	01121	CB5605
A32R3409	321-0342-00			RES.,FXD,FILM:35.7K OHM,1%,0.125W	91637	MFF1816G35701F
A32R3412	321-0377-00			RES.,FXD,FILM:82.5K OHM,1%,0.125W	91637	MFF1816G82501F
A32R3413	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
A32R3417	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A32R3418	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
A32R3419	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A32R3421	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A32R3423	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A32R3424	315-0244-00			RES.,FXD,CMPSN:240K OHM,5%,0.25W	01121	CB2445
A32R3428	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
A32R3429	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
A32R3431	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
A32R3432	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
A32R3434	315-0274-00			RES.,FXD,CMPSN:270K OHM,5%,0.25W	01121	CB2745
A32R3436	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
A32R3438	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A32R3439	315-0184-00			RES.,FXD,CMPSN:180K OHM,5%,0.25W	01121	CB1845
A32R3441	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
A32R3445	315-0184-00			RES.,FXD,CMPSN:180K OHM,5%,0.25W	01121	CB1845
A32R3446	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A32R3448	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A32R3450	315-0304-00			RES.,FXD,CMPSN:300K OHM,5%,0.25W	01121	CB3045
A32R3452	315-0125-00			RES.,FXD,CMPSN:1.2M OHM,5%,0.25W	01121	CB1255
A32R3454	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A32R3458	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A32R3459	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
A32R3463	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A32R3465	311-1198-00			RES.,VAR,NONWIR:20K OHM,20%,0.5W	73138	72-29-0
A32R3466	315-0335-00			RES.,FXD,CMPSN:3.3M OHM,5%,0.25W	01121	CB3355
A32R3470	321-0385-07			RES.,FXD,FILM:100K OHM,0.1%,0.125W	91637	MFF1816C10002B
A32R3472	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
A32R3473	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A32R3474	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A32R3475	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
A32R3476	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A32R3477	315-0125-00			RES.,FXD,CMPSN:1.2M OHM,5%,0.25W	01121	CB1255
A32R3479	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
A32R3482	321-0318-07			RES.,FXD,FILM:20K OHM,0.1%,0.125W	24546	NE55E2002B
A32R3484	321-0756-04			RES.,FXD,FILM:50K OHM,0.1%,0.125W	91637	MFF1816D50001B
A32R3487	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A32R3489	321-0318-07			RES.,FXD,FILM:20K OHM,0.1%,0.125W	24546	NE55E2002B
A32R3490	311-1247-00			RES.,VAR,NONWIR:1M OHM,10%,0.50W	73138	72-35-0
A32R3494	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A32R3503	321-0435-00			RES.,FXD,FILM:332K OHM,1%,0.125W	91637	MFF1816G33202F
A32R3504	321-0397-00			RES.,FXD,FILM:133K OHM,1%,0.125W	91637	MFF1816G13302F
A32R3506	315-0161-00			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
A32R3508	321-0376-00			RES.,FXD,FILM:80.6K OHM,1%,0.125W	91637	MFF1816G80601F
A32R3509	321-0393-00			RES.,FXD,FILM:121K OHM,1%,0.125W	91637	MFF1816G12102F
A32R3510	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
A32R3512	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A32R3513	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
A32R3515	321-0373-00			RES.,FXD,FILM:75K OHM, 1%,0.125W	91637	MFF1816G75001F
A32R3518	321-0373-00			RES.,FXD,FILM:75K OHM, 1%,0.125W	91637	MFF1816G75001F
A32R3522	315-0161-00			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
A32R3525	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
A32R3528	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
A32R3530	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
A32R3532	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
A32R3534	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
A32R3550	321-0396-00			RES.,FXD,FILM:130K OHM,1%,0.125W	91637	MFF1816G13002F
A32R3551	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A32R3553	315-0106-00			RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
A32R3556	321-0618-04			RES.,FXD,FILM:250K OHM,0.1%,0.125W	07716	OBD
A32R3557	321-0350-00			RES.,FXD,FILM:43.2K OHM,1%,0.125W	91637	MFF1816G43201F
A32R3560	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
A32R3562	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
A32R3563	315-0334-00			RES.,FXD,CMPSN:330K OHM,5%,0.25W	01121	CB3345
A32R3564	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A32R3565	315-0225-00			RES.,FXD,CMPSN:2.2M OHM,5%,0.25W	01121	CB2255
A32R3566	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
A32R3567	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A32R3569	321-0618-04			RES.,FXD,FILM:250K OHM,0.1%,0.125W	07716	OBD
A32R3571	321-0289-07			RES.,FXD,FILM:10K OHM,0.1%,0.125W	91637	MFF1816C10001B
A32R3572	321-0385-07			RES.,FXD,FILM:100K OHM,0.1%,0.125W	91637	MFF1816C10002B
A32R3574	321-0289-07			RES.,FXD,FILM:10K OHM,0.1%,0.125W	91637	MFF1816C10001B
A32R3575	321-0385-07			RES.,FXD,FILM:100K OHM,0.1%,0.125W	91637	MFF1816C10002B
A32R3577	321-0373-00			RES.,FXD,FILM:75K OHM, 1%,0.125W	91637	MFF1816G75001F
A32R3578	321-0389-00			RES.,FXD,FILM:110K OHM,1%,0.125W	91637	MFF1816G11002F
A32R3579	321-0338-00			RES.,FXD,FILM:32.4K OHM,1%,0.125W	91637	MFF1816G32401F
A32R3580	321-0807-00			RES.,FXD,FILM:900K OHM,1%,0.125W	91637	HFF1104F90002F
A32R3581	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A32R3584	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
A32R3585	321-0361-00			RES.,FXD,FILM:56.2K OHM,1%,0.125W	91637	MFF1816G56201F
A32R3586	321-0361-00			RES.,FXD,FILM:56.2K OHM,1%,0.125W	91637	MFF1816G56201F
A32R3587	321-0289-07			RES.,FXD,FILM:10K OHM,0.1%,0.125W	91637	MFF1816C10001B
A32R3588	321-0603-07			RES.,FXD,FILM:15K OHM,0.1%,0.125W	91637	MFF1816C15001B
A32R3589	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
A32R3590	321-0385-07			RES.,FXD,FILM:100K OHM,0.1%,0.125W	91637	MFF1816C10002B
A32R3591	321-0924-07			RES.,FXD,FILM:40K OHM,0.1%,0.125W	91637	MFF1816C40001B
A32R3593	321-0289-07			RES.,FXD,FILM:10K OHM,0.1%,0.125W	91637	MFF1816C10001B

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A32R3595	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
A32R3597	321-0318-07			RES.,FXD,FILM:20K OHM,0.1%,0.125W	24546	NE55E2002B
A32R3599	321-0289-07			RES.,FXD,FILM:10K OHM,0.1%,0.125W	91637	MFF1816C10001B
A32S3400	260-1992-00			SWITCH,PUSH:6 BUTTON,2 AND4 POLE,PRESSURE	71590	2KBM0510001297
A32TP3411	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A32TP3412	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A32TP3413	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A32TP3415	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A32TP3423	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A32TP3433	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A32TP3454	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A32TP3463	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A32U3415	156-0158-03			MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
A32U3423	156-0495-02			MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
A32U3424	156-1200-01			MICROCIRCUIT,LI:OPERATIONAL AMPL.QUAD BIFET	01295	TL074CN/PEP3
A32U3434	156-0644-03			MICROCIRCUIT,DI:QUAD BILATERAL SW,BURN-IN	04713	MC14066BCLD
A32U3435	156-0350-05			MICROCIRCUIT,DI:QUAD 2 INPUT NAND GATE,CHK	80009	156-0350-05
A32U3443	156-0495-02			MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
A32U3445	156-0349-06			MICROCIRCUIT,DI:QUAD 2 INP NOR GATE,CHK	80009	156-0349-06
A32U3446	156-0158-03			MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
A32U3451	156-0158-03			MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
A32U3453	156-0158-03			MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
A32U3454	156-1369-00			MICROCIRCUIT,DI:OCTAL CNTR/DRIVER,SCRN	04713	MC14022BCLD
A32U3455	156-0876-02			MICROCIRCUIT,DI:HEX SCHMITT TRIGGER,SCRN	04713	MC14584BCLD
A32U3456	156-0158-03			MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
A32U3462	156-0512-02			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER,SEL	80009	156-0512-02
A32U3464	156-0366-02			MICROCIRCUIT,DI:DUAL D FLIP-FLOP,CHK	80009	156-0366-02
A32U3465	156-0349-06			MICROCIRCUIT,DI:QUAD 2 INP NOR GATE,CHK	80009	156-0349-06
A32VR3413	152-0217-00			SEMICOND DEVICE:ZENER,0.4W,8.2V,5%	04713	SZG20
A32VR3475	152-0217-00			SEMICOND DEVICE:ZENER,0.4W,8.2V,5%	04713	SZG20
A32VR3581	152-0279-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZG35010RL
A32VR3582	152-0279-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZG35010RL

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A33	----- -----			CKT BOARD ASSY:CONDITIONER		
A33C3601	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A33C3602	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
A33C3603	290-0572-00			CAP.,FXD,ELCTLT:0.1UF,20%,50V	56289	196D104X0050HA1
A33C3610	285-1056-00			CAP.,FXD,PLSTC:1UF,2%,50V	14752	650B1A105G
A33C3612	285-1056-00			CAP.,FXD,PLSTC:1UF,2%,50V	14752	650B1A105G
A33C3616	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A33C3619	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A33C3625	290-0535-02			CAP.,FXD,ELCTLT:33UF,20%,10V	56289	196D336X0010K
A33C3629	290-0530-01			CAP.,FXD,ELCTLT:68UF,20%,6V	56289	196D 156X0020K
A33C3636	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A33C3640	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A33C3643	290-0722-01			CAP.,FXD,ELCTLT:100UF,20%,10V	51984	NDK 107M10C
A33C3644	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A33C3646	283-0763-00	XC010300		CAP.,FXD,MICA,DI:430PF,1%,100V	72982	390049X5P0470K
A33C3654	290-0724-01			CAP.,FXD,ELCTLT:330UF,20%,6V	56289	196D337X0006T
A33C3655	290-0535-02			CAP.,FXD,ELCTLT:33UF,20%,10V	56289	196D336X0010K
A33C3656	283-0763-00	XC010300		CAP.,FXD,MICA,DI:430PF,1%,100V	72982	390049X5P0470K
A33C3664	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A33C3692	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A33C3868	283-0763-00	XC010300		CAP.,FXD,MICA,DI:430PF,1%,100V	72982	390049X5P0470K
A33C3878	283-0763-00	XC010300		CAP.,FXD,MICA,DI:430PF,1%,100V	72982	390049X5P0470K
A33C3890	283-0763-00	XC010300		CAP.,FXD,MICA,DI:430PF,1%,100V	72982	390049X5P0470K
A33C3704	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A33C3763	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A33C3766	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A33C3768	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145651 104Z
A33C3771	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145651 104Z
A33C3772	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
A33C3778	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145651 104Z
A33C3779	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145651 104Z
A33C3784	290-0809-00			CAP.,FXD,ELCTLT:6.8UF,20%,50V	56289	196D685X0050PE4
A33C3787	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A33C3788	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A33C3789	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A33C3792	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145651 104Z
A33C3794	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A33C3797	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A33C3799	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A33C3837	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
A33C3851	290-0580-00			CAP.,FXD,ELCTLT:0.27UF,20%,50V	56289	196D274X0050HA1
A33C3861	290-0722-01			CAP.,FXD,ELCTLT:100UF,20%,10V	51984	NDK 107M10C
A33C3862	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A33C3865	290-0722-01			CAP.,FXD,ELCTLT:100UF,20%,10V	51984	NDK 107M10C
A33C3867	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A33C3870	290-0722-01			CAP.,FXD,ELCTLT:100UF,20%,10V	51984	NDK 107M10C
A33C3873	290-0722-01			CAP.,FXD,ELCTLT:100UF,20%,10V	51984	NDK 107M10C
A33C3874	290-0722-01			CAP.,FXD,ELCTLT:100UF,20%,10V	51984	NDK 107M10C
A33C3876	290-0722-01			CAP.,FXD,ELCTLT:100UF,20%,10V	51984	NDK 107M10C
A33C3877	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A33C3879	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
A33C3881	290-0722-01			CAP.,FXD,ELCTLT:100UF,20%,10V	51984	NDK 107M10C
A33C3884	290-0722-01			CAP.,FXD,ELCTLT:100UF,20%,10V	51984	NDK 107M10C
A33C3885	290-0722-01			CAP.,FXD,ELCTLT:100UF,20%,10V	51984	NDK 107M10C
A33C3887	290-0722-01			CAP.,FXD,ELCTLT:100UF,20%,10V	51984	NDK 107M10C
A33C3889	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A33C3895	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A33CR3605	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3607	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3630	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3631	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3633	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3658	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3671	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3685	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3686	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3687	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3706	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3760	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3765	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3771	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3776	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3782	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3783	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3786	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3795	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3796	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3834	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3836	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3848	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3849	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3856	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3858	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3859	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3872	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33CR3882	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A33Q3670	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A33Q3675	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A33Q3780	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
A33Q3852	151-0508-00			TRANSISTOR:UJT,SI,2N6027,TO-98	03508	2N6027
A33R3601	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
A33R3603	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A33R3605	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A33R3607	321-0413-00			RES.,FXD,FILM:196K OHM,1%,0.125W	91637	MFF1816G19602F
A33R3608	321-0413-00			RES.,FXD,FILM:196K OHM,1%,0.125W	91637	MFF1816G19602F
A33R3610	321-0443-00			RES.,FXD,FILM:402K OHM,1%,0.125W	91637	MFF1816G40202F
A33R3612	321-0414-00			RES.,FXD,FILM:200K OHM,1%,0.125W	91637	MFF1816G20002F
A33R3616	315-0304-00			RES.,FXD,CMPSN:300K OHM,5%,0.25W	01121	CB3045
A33R3619	315-0304-00			RES.,FXD,CMPSN:300K OHM,5%,0.25W	01121	CB3045
A33R3620	307-0509-00			RES NTWK,FXD FI:7,100K OHM,5%	01121	208A104
A33R3621	321-0202-09			RES.,FXD,FILM:1.24K OHM,1%,0.125W	91637	MFF1816C12400F
A33R3622	311-1036-00			RES.,VAR,NONWIR:TRMR,200 OHM,0.5W	73138	68-76-0
A33R3623	321-0191-09			RES.,FXD,FILM:953 OHM,1%,0.125W	24546	NE55E9530F
A33R3625	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
A33R3626	321-0414-00			RES.,FXD,FILM:200K OHM,1%,0.125W	91637	MFF1816G20002F
A33R3628	315-0363-00			RES.,FXD,CMPSN:36K OHM,5%,0.25W	01121	CB3635
A33R3629	321-0349-00			RES.,FXD,FILM:42.2K OHM,1%,0.125W	91637	MFF1816G42201F
A33R3630	307-0509-00			RES NTWK,FXD FI:7,100K OHM,5%	01121	208A104
A33R3631	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A33R3633	321-0413-00			RES.,FXD,FILM:196K OHM,1%,0.125W	91637	MFF1816G19602F
A33R3634	321-0413-00			RES.,FXD,FILM:196K OHM,1%,0.125W	91637	MFF1816G19602F
A33R3636	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
A33R3638	321-0414-00			RES.,FXD,FILM:200K OHM,1%,0.125W	91637	MFF1816G20002F
A33R3639	321-0378-00			RES.,FXD,FILM:84.5K OHM,1%,0.125W	91637	MFF1816G84501F

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A33R3640	307-0509-00			RES NTWK,FXD FI:7,100K OHM,5%	01121	208A104
A33R3641	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
A33R3643	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A33R3644	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A33R3646	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
A33R3648	321-0324-00			RES.,FXD,FILM:23.2K OHM,1%,0.125W	91637	MFF1816G23201F
A33R3650	311-1943-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	73138	68-10-0
A33R3652	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A33R3654	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A33R3655	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
A33R3656	311-1943-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	73138	68-10-0
A33R3657	321-0324-00			RES.,FXD,FILM:23.2K OHM,1%,0.125W	91637	MFF1816G23201F
A33R3658	315-0433-00			RES.,FXD,CMPSN:43K OHM,5%,0.25W	01121	CB4335
A33R3659	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
A33R3660	307-0509-00			RES NTWK,FXD FI:7,100K OHM,5%	01121	208A104
A33R3661	321-1722-07			RES.,FXD,FILM:3.39K OHM,0.1%,0.125W	24546	NE55E3391B
A33R3662	321-0997-07			RES.,FXD,FILM:17.105K OHM,0.1%,0.125W	24546	NE55E17.105KUB
A33R3664	321-1682-07			RES.,FXD,FILM:5.7K OHM,0.1%,0.125W	91637	MFF1816C57000B
A33R3665	321-1296-07			RES.,FXD,FILM:12K OHM,0.1%,0.125W	91637	MFF1816C12001B
A33R3667	321-0245-00			RES.,FXD,FILM:3.48K OHM,1%,0.125W	91637	MFF1816G34800F
A33R3668	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
A33R3669	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
A33R3671	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
A33R3672	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
A33R3674	321-0137-00			RES.,FXD,FILM:261 OHM,1%,0.125W	91637	MFF1816G261R0F
A33R3675	321-0168-00			RES.,FXD,FILM:549 OHM,1%,0.125W	91637	MFF1816G549R0F
A33R3676	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A33R3677	321-0190-00			RES.,FXD,FILM:931 OHM,1%,0.125W	91637	MFF1816G931R0F
A33R3678	321-0191-09			RES.,FXD,FILM:953 OHM,1%,0.125W	24546	NE55E9530F
A33R3679	321-0171-09			RES.,FXD,FILM:590 OHM,1%,0.125W	91637	MFF1816C590R0F
A33R3680	311-1175-00			RES.,VAR,NONWIR:100 OHM,10%,0.50W	73138	68WR100
A33R3681	321-0193-07			RES.,FXD,FILM:1K OHM,0.1%,0.125W	91637	MFF1816C10000B
A33R3682	321-0773-07			RES.,FXD,FILM:400 OHM,0.1%,0.125W	24546	NE55E4000B
A33R3683	321-0207-07			RES.,FXD,FILM:1.4K OHM,0.1%,0.125W	24546	NE55E140LB
A33R3685	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
A33R3686	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A33R3687	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
A33R3688	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
A33R3690	321-0202-09			RES.,FXD,FILM:1.24K OHM,1%,0.125W	91637	MFF1816C12400F
A33R3692	311-1944-00			RES.,VAR,NONWIR:1K OHM,10%,0.50W	32997	3299W-R27-102
A33R3693	321-0249-09			RES.,FXD,FILM:3.83K OHM,1%,0.125W	91637	MFF1816C38300F
A33R3695	321-0202-09			RES.,FXD,FILM:1.24K OHM,1%,0.125W	91637	MFF1816C12400F
A33R3701	321-1722-07			RES.,FXD,FILM:3.39K OHM,0.1%,0.125W	24546	NE55E3391B
A33R3702	321-0997-07			RES.,FXD,FILM:17.105K OHM,0.1%,0.125W	24546	NE55E17.105KUB
A33R3704	321-1682-07			RES.,FXD,FILM:5.7K OHM,0.1%,0.125W	91637	MFF1816C57000B
A33R3705	321-0245-00			RES.,FXD,FILM:3.48K OHM,1%,0.125W	91637	MFF1816G34800F
A33R3706	321-1296-07			RES.,FXD,FILM:12K OHM,0.1%,0.125W	91637	MFF1816C12001B
A33R3707	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
A33R3708	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
A33R3710	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
A33R3711	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
A33R3713	321-0191-09			RES.,FXD,FILM:953 OHM,1%,0.125W	24546	NE55E9530F
A33R3714	321-0202-09			RES.,FXD,FILM:1.24K OHM,1%,0.125W	91637	MFF1816C12400F
A33R3715	311-1036-00			RES.,VAR,NONWIR:TRMR,200 OHM,0.5W	73138	68-76-0
A33R3717	321-0191-09			RES.,FXD,FILM:953 OHM,1%,0.125W	24546	NE55E9530F
A33R3718	321-0171-09			RES.,FXD,FILM:590 OHM,1%,0.125W	91637	MFF1816C590R0F
A33R3719	311-1175-00			RES.,VAR,NONWIR:100 OHM,10%,0.50W	73138	68WR100

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A33R3721	321-0193-07			RES.,FXD,FILM:1K OHM,0.1%,0.125W	91637	MFF1816C10000B
A33R3722	321-0773-07			RES.,FXD,FILM:400 OHM,0.1%,0.125W	24546	NE55E4000B
A33R3723	321-0207-07			RES.,FXD,FILM:1.4K OHM,0.1%,0.125W	24546	NE55E140LB
A33R3726	321-0193-07			RES.,FXD,FILM:1K OHM,0.1%,0.125W	91637	MFF1816C10000B
A33R3727	321-0193-07			RES.,FXD,FILM:1K OHM,0.1%,0.125W	91637	MFF1816C10000B
A33R3729	321-0193-07			RES.,FXD,FILM:1K OHM,0.1%,0.125W	91637	MFF1816C10000B
A33R3730	321-0193-07			RES.,FXD,FILM:1K OHM,0.1%,0.125W	91637	MFF1816C10000B
A33R3732	311-1943-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	73138	68-10-0
A33R3760	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A33R3761	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
A33R3763	315-0514-00			RES.,FXD,CMPSN:510K OHM,5%,0.25W	01121	CB5145
A33R3765	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A33R3766	315-0824-00			RES.,FXD,CMPSN:820K OHM,5%,0.25W	01121	CB8245
A33R3767	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A33R3768	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
A33R3769	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A33R3771	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
A33R3772	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
A33R3774	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A33R3775	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
A33R3776	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
A33R3778	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
A33R3779	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
A33R3780	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A33R3781	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A33R3782	315-0184-00			RES.,FXD,CMPSN:180K OHM,5%,0.25W	01121	CB1845
A33R3783	315-0135-00			RES.,FXD,CMPSN:1.3M OHM,5%,0.25W	01121	CB1355
A33R3784	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
A33R3786	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
A33R3787	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
A33R3788	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
A33R3789	315-0475-00			RES.,FXD,CMPSN:4.7M OHM,5%,0.25W	01121	CB4755
A33R3791	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
A33R3792	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
A33R3793	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
A33R3794	315-0394-00			RES.,FXD,CMPSN:390K OHM,5%,0.25W	01121	CB3945
A33R3795	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A33R3796	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
A33R3797	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A33R3798	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
A33R3830	321-0271-00			RES.,FXD,FILM:6.49K OHM,1%,0.125W	91637	MFF1816G64900F
A33R3831	321-0231-00			RES.,FXD,FILM:2.49K OHM,1%,0.125W	91637	MFF1816G24900F
A33R3833	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
A33R3834	315-0335-00			RES.,FXD,CMPSN:3.3M OHM,5%,0.25W	01121	CB3355
A33R3836	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
A33R3837	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
A33R3839	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A33R3840	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
A33R3843	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
A33R3845	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
A33R3846	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
A33R3848	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
A33R3851	315-0684-00			RES.,FXD,CMPSN:680K OHM,5%,0.25W	01121	CB6845
A33R3852	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A33R3854	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A33R3855	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
A33R3856	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A33R3857	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A33R3858	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A33R3859	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A33R3860	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A33R3861	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A33R3862	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A33R3863	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
A33R3865	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A33R3867	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A33R3868	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
A33R3870	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A33R3871	315-0275-00			RES.,FXD,CMPSN:2.7M OHM,5%,0.25W	01121	CB2755
A33R3877	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A33R3878	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
A33R3880	315-0275-00			RES.,FXD,CMPSN:2.7M OHM,5%,0.25W	01121	CB2755
A33R3881	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A33R3887	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A33R3889	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A33R3890	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
A33R3892	321-0289-07			RES.,FXD,FILM:10K OHM,0.1%,0.125W	91637	MFF1816C10001B
A33R3893	321-0993-07			RES.,FXD,FILM:90K OHM,0.1%,0.125W	91637	MFF1816C90001B
A33R3895	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A33S3610	260-1223-00			SWITCH,PUSH:4PDT,MOMENTARY	80009	260-1223-00
A33TP3619	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A33TP3626	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A33TP3627	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A33TP3650	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A33TP3652	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A33TP3655	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A33TP3661	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A33TP3695	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A33U3607	156-0067-13			MICROCIRCUIT,LI:OPNL AMPL,SELECTED	04713	MC1741CUDS
A33U3610	156-0158-03			MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
A33U3611	156-0495-02			MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
A33U3612	156-0495-02			MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
A33U3613	156-0515-02			MICROCIRCUIT,DI:TRIPLE 3-CHANMUX,SEL	80009	156-0515-02
A33U3614	156-0495-02			MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
A33U3615	156-0515-02			MICROCIRCUIT,DI:TRIPLE 3-CHANMUX,SEL	80009	156-0515-02
A33U3616	156-1152-01			MICROCIRCUIT,DI:PRCN RETRIGGERABLE,BURN-IN	80009	156-1152-01
A33U3617	156-1152-01			MICROCIRCUIT,DI:PRCN RETRIGGERABLE,BURN-IN	80009	156-1152-01
A33U3619	156-0350-05			MICROCIRCUIT,DI:QUAD 2 INPUT NAND GATE,CHK	80009	156-0350-05
A33U3620	156-0515-02			MICROCIRCUIT,DI:TRIPLE 3-CHANMUX,SEL	80009	156-0515-02
A33U3621	156-0495-02			MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
A33U3622	156-1352-00			MICROCIRCUIT,DI:QUAD &/OR SELECT GATE,SCRN	02735	CD4019BFX
A33U3623	156-0876-02			MICROCIRCUIT,DI:HEX SCHMITT TRIGGER,SCRN	04713	MC14584BCLD
A33U3624	156-0350-05			MICROCIRCUIT,DI:QUAD 2 INPUT NAND GATE,CHK	80009	156-0350-05
A33U3625	156-0753-01			MICROCIRCUIT,DI:EXPEN 4-W 2-INP AOI GATE	02735	CD4086BFX
A33U3627	156-1152-01			MICROCIRCUIT,DI:PRCN RETRIGGERABLE,BURN-IN	80009	156-1152-01
A33U3630	156-0259-02			MICROCIRCUIT,LI:5-XSTR ALL INDEP,SCRN	02735	CA3083EX
A33U3631	156-0753-01			MICROCIRCUIT,DI:EXPEN 4-W 2-INP AOI GATE	02735	CD4086BFX
A33U3632	156-0753-01			MICROCIRCUIT,DI:EXPEN 4-W 2-INP AOI GATE	02735	CD4086BFX
A33U3633	156-0494-02			MICROCIRCUIT,DI:HEX INV/BUFF,SELECTED	80009	156-0494-02
A33U3634	156-0349-06			MICROCIRCUIT,DI:QUAD 2 INP NOR GATE,CHK	80009	156-0349-06
A33U3636	156-0495-02			MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
A33U3637	156-0495-02			MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
A33U3638	156-0495-02			MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
A33U3640	156-0756-01			MICROCIRCUIT,DI:BCD DECIMAL DECODER,SCRN	04713	MC14028BCLD

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A33U3641	156-0513-02			MICROCIRCUIT,DI:8-CHANNEL MUX,SEL	80009	156-0513-02
A33U3642	156-0350-05			MICROCIRCUIT,DI:QUAD 2 INPUT NAND GATE,CHK	80009	156-0350-05
A33U3643	156-0495-02			MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
A33U3644	156-0495-02			MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
A33U3645	156-0349-06			MICROCIRCUIT,DI:QUAD 2 INP NOR GATE,CHK	80009	156-0349-06
A33U3646	156-0158-03			MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
A33U3647	156-0495-02			MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
A33U3648	156-0644-03			MICROCIRCUIT,DI:QUAD BILATERAL SW,BURN-IN	04713	MC14066BCLD
A33U3649	156-0767-02			MICROCIRCUIT,DI:HEX GATE 4 INV,SCRN	04713	MC14572UBCLD
A33U3650	156-0513-02			MICROCIRCUIT,DI:8-CHANNEL MUX,SEL	80009	156-0513-02
A33U3652	156-1152-01			MICROCIRCUIT,DI:PRCN RETRIGGERABLE,BURN-IN	80009	156-1152-01
A33U3653	156-0515-02			MICROCIRCUIT,DI:TRIPLE 3-CHAN MUX,SEL	80009	156-0515-02
A33U3655	156-1152-01			MICROCIRCUIT,DI:PRCN RETRIGGERABLE,BURN-IN	80009	156-1152-01
A33U3656	156-0801-01			MICROCIRCUIT,DI:DUAL 4-BIT STATIC SR,SCRN	04713	MC14015BCLD

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A34	----- -----			CKT BOARD ASSY:RATE ALARM CONTROL		
A34CR3827	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A34CR3828	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A34R3741	321-0281-00			RES.,FXD,FILM:8.25K OHM,1%,0.125W	91637	MFF1816G82500F
A34R3742	321-0264-00			RES.,FXD,FILM:5.49K OHM,1%,0.125W	91637	MFF1816G54900F
A34R3743	321-0243-00			RES.,FXD,FILM:3.32K OHM,1%,0.125W	91637	MFF1816G33200F
A34R3745	311-2068-00			RES.,VAR,NONWIR:PNL,50K OHM,10%,0.25W,DPST	12697	CM41752
A34R3747	321-0295-00			RES.,FXD,FILM:11.5K OHM,1%,0.125W	91637	MFF1816G11501F
A34R3748	321-0264-00			RES.,FXD,FILM:5.49K OHM,1%,0.125W	91637	MFF1816G54900F
A34R3749	311-2069-00			RES.,VAR,NONWIR:PNL,50K OHM,10%,0.25W,DPST	12697	CM41753
A34R3751	321-0308-00			RES.,FXD,FILM:15.8K OHM,1%,0.125W	91637	MFF1816G15801F
A34R3752	321-0264-00			RES.,FXD,FILM:5.49K OHM,1%,0.125W	91637	MFF1816G54900F
A34R3753	311-2068-00			RES.,VAR,NONWIR:PNL,50K OHM,10%,0.25W,DPST	12697	CM41752
A34R3755	321-0332-00			RES.,FXD,FILM:28K OHM,1%,0.125W	91637	MFF1816G28001F
A34R3756	321-0264-00			RES.,FXD,FILM:5.49K OHM,1%,0.125W	91637	MFF1816G54900F
A34R3757	311-2069-00			RES.,VAR,NONWIR:PNL,50K OHM,10%,0.25W,DPST	12697	CM41753
A35	----- -----			CKT BOARD ASSY:READOUT SWITCH		
A35C3802	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N145X5R0104K
A35CR3821	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A35CR3822	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A35DS3798	150-1049-00			LT EMITTING DIO:RED/GREEN	05464	232RG 80317
A35DS3805	150-1095-00			LT EMITTING DIO:RED,635-660NM60MA MAX 2.2V	50434	5082-4655
A35DS4198	150-1033-00			LT EMITTING DIO:YELLOW,585NM,40MA MAX	50434	5082-4584
A35R3802	315-0624-00			RES.,FXD,CMPSN:620K OHM,5%,0.25W	01121	CB6245
A35R3803	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A35R3804	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A35R3805	301-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.50W	01121	EB6815
A35S3780	260-1686-00			SWITCH,PUSH:1 STA,2 POLE,MOMENTARY	80009	260-1686-00
A35S3820	260-1882-00			SWITCH,PUSH:2 POLE,6 BTN,READOUT SELECT	80009	260-1882-00
A35U3801	156-1126-01			MICROCIRCUIT,LI:VOLTAGE COMPARATOR,SEL	04713	MLM311U

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A36	----- -----			CKT BOARD ASSY:DVM		
A36C3900	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A36C3907	285-0808-00			CAP.,FXD,PLSTC:0.1UF,10%,50V	56289	LP66A1A104K004
A36C3908	285-0808-00			CAP.,FXD,PLSTC:0.1UF,10%,50V	56289	LP66A1A104K004
A36C3913	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
A36C3920	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
A36C3921	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	274C10
A36C3922	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
A36C3923	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	274C10
A36C3925	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
A36C3971	281-0814-00	XC010200		CAP.,FXD,CER DI:100PF,10%,100V	04222	GC70-1-A101K
A36CR3913	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
A36CR3922	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
A36CR3923	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
A36CR3924	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
A36CR3925	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
A36CR3971	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
A36CR3974	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
A36CR3978	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
A36CR3980	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
A36Q3907	151-0443-00			TRANSISTOR:SILICON,PNP	80009	151-0443-00
A36Q3908	151-0443-00			TRANSISTOR:SILICON,PNP	80009	151-0443-00
A36Q3917	151-0443-00			TRANSISTOR:SILICON,PNP	80009	151-0443-00
A36Q3918	151-0443-00			TRANSISTOR:SILICON,PNP	80009	151-0443-00
A36Q3927	151-0444-00			TRANSISTOR:SILICON,NPN	80009	151-0444-00
A36Q3928	151-0444-00			TRANSISTOR:SILICON,NPN	80009	151-0444-00
A36Q3937	151-0444-00			TRANSISTOR:SILICON,NPN	80009	151-0444-00
A36Q3938	151-0444-00			TRANSISTOR:SILICON,NPN	80009	151-0444-00
A36Q3942	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A36Q3961	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
A36Q3971	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A36Q3977	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
A36Q3986	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
A36Q3987	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
A36Q3988	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
A36R3900	311-1860-00			RES.,VAR,NONWIR:TRMR,10K OHM,0.50W	32997	3299X-R27-103
A36R3901	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
A36R3902	321-0341-00			RES.,FXD,FILM:34.8K OHM,1%,0.125W	91637	MFF1816G34801F
A36R3903	315-0106-00			RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
A36R3905	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A36R3907	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
A36R3909	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
A36R3910	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
A36R3912	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
A36R3915	321-0932-00			RES.,FXD,FILM:2.5K OHM,1%,0.125W	24546	NA55D2501F
A36R3917	321-0932-00			RES.,FXD,FILM:2.5K OHM,1%,0.125W	24546	NA55D2501F
A36R3918	321-0816-00			RES.,FXD,FILM:5K OHM,1%,0.125W	24546	NA55D5001F
A36R3920	321-0816-00			RES.,FXD,FILM:5K OHM,1%,0.125W	24546	NA55D5001F
A36R3922	315-0106-00			RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
A36R3923	315-0106-00			RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
A36R3925	315-0304-00			RES.,FXD,CMPSN:300K OHM,5%,0.25W	01121	CB3045
A36R3934	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A36R3937	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A36R3940	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A36R3943	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A36R3949	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A36R3950	315-0514-00			RES.,FXD,CMPSN:510K OHM,5%,0.25W	01121	CB5145

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A36R3951	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
A36R3953	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A36R3955	315-0514-00			RES.,FXD,CMPSN:510K OHM,5%,0.25W	01121	CB5145
A36R3956	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
A36R3957	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A36R3959	315-0514-00			RES.,FXD,CMPSN:510K OHM,5%,0.25W	01121	CB5145
A36R3960	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
A36R3961	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A36R3963	315-0514-00			RES.,FXD,CMPSN:510K OHM,5%,0.25W	01121	CB5145
A36R3964	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
A36R3965	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A36R3970	315-0275-00			RES.,FXD,CMPSN:2.7M OHM,5%,0.25W	01121	CB2755
A36R3971	315-0103-00	XC010200		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A36R3972	315-0275-00			RES.,FXD,CMPSN:2.7M OHM,5%,0.25W	01121	CB2755
A36R3973	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
A36R3975	307-0508-00			RES NTWK,FXD FI:15,1M OHM,5%,1.125W	01121	316A105
A36R3976	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
A36R3981	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
A36R3982	307-0509-00			RES NTWK,FXD FI:7,100K OHM,5%	01121	208A104
A36R3983	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
A36R3984	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
A36R3985	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
A36R3987	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
A36R3988	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A36T3946	120-1042-00			XFMR,PWR,STU:READOUT,POT CORE	80009	120-1042-00
A36TP3900	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A36TP3902	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A36TP3903	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A36TP3904	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A36TP3905	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A36TP3913	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A36TP3918	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A36TP3920	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A36TP3937	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A36TP3939	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A36U3913	156-0800-01			MICROCIRCUIT,DI:QUAD LATCH,SCRN	04713	MC14042BCLD
A36U3921	156-1118-00			MICROCIRCUIT,LI:ANALOG/DIGITAL CONVERTER	04713	MC14433PD
A36U3923	156-0330-02			MICROCIRCUIT,DI:HEX BUFFER	04713	MC14050BCLD
A36U3924	156-1368-00			MICROCIRCUIT,DI:DUAL BINARY	04713	MC14555BCL
A36U3943	156-0753-01			MICROCIRCUIT,DI:EXPEN 4-W 2-INP AOI GATE	02735	CD4086BFX
A36U3944	156-0579-02			MICROCIRCUIT,DI:DUAL 4 BIT BIN COUNTER,SEL	80009	156-0579-02
A36U3950	156-0158-03			MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
A36U3953	156-0925-00			MICROCIRCUIT,DI:DUAL 2 WIDE 2INP	02735	CD4085BF
A36U3954	156-0366-02			MICROCIRCUIT,DI:DUAL D FLIP-FLOP,CHK	80009	156-0366-02
A36U3962	156-0752-01			MICROCIRCUIT,DI:DUAL BCD UP COUNTER,SCRN	04713	MC14518BCLD
A36U3973	156-0494-02			MICROCIRCUIT,DI:HEX INV/BUFF,SELECTED	80009	156-0494-02
A36U3974	156-0284-03			MICROCIRCUIT,DI:BCD 7 SEG DCDR/DRVR	27014	DS8880NA+
A36U3976	156-0350-05			MICROCIRCUIT,DI:QUAD 2 INPUT NAND GATE,CHK	80009	156-0350-05

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A37	----- -----			CKT BOARD ASSY:DIGITAL DISPLAY		
A37U4010	150-1039-01			LAMP,GLOW,RDOUT:NEON,7 SEGMENT,1.5 DIGIT	73138	SP331-02
A37U4020	150-1015-01			LAMP,GLOW,RDOUT:ORANGE,2.0 DIGIT	73138	SP332-01
A38	----- -----			CKT BOARD ASSY:MAIN		
A38C4101	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A38C4102	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A38C4103	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A38C4104	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A38C4105	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A38C4106	281-0797-00			CAP.,FXD,CER DI:15PF,10%,100V	72982	8035D9AADC0G150K
A38C4107	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	8035D9AADC1G470K
A38C4110	281-0814-00			CAP.,FXD,CER DI:100PF,10%,100V	04222	GC70-1-A101K
A38C4115	281-0826-00			CAP.,FXD,CER DI:2200PF,5%,100V	04222	GC101C222J
A38C4117	281-0812-00			CAP.,FXD,CER DI:1000PF,10%,100V	72982	8035D9AADX7R102K
A38C4119	281-0826-00			CAP.,FXD,CER DI:2200PF,5%,100V	04222	GC101C222J
A38C4123	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
A38C4128	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
A38C4131	281-0772-00			CAP.,FXD,CER DI:0.0047UF,10%,100V	04222	GC701C472K
A38C4136	281-0812-00			CAP.,FXD,CER DI:1000PF,10%,100V	72982	8035D9AADX7R102K
A38C4151	281-0772-00			CAP.,FXD,CER DI:0.0047UF,10%,100V	04222	GC701C472K
A38C4166	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	GC70-1C103K
A38C4180	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	GC70-1C103K
A38C4182	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	GC70-1C103K
A38C4189	290-0722-01			CAP.,FXD,ELCTLT:100UF,20%,10V	51984	NDK 107M10C
A38C4204	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	8035D9AADC1G470K
A38C4208	283-0370-00			CAP.,FXD,CER DI:0.027UF,5%,100V	72982	8131N153X7R0273J
A38C4212	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A38C4233	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	8035D9AADC1G470K
A38C4235	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A38C4260	290-0719-01			CAP.,FXD,ELCTLT:47UF,20%,25V	80009	290-0719-01
A38C4267	290-0508-00			CAP.,FXD,ELCTLT:18,000UF,+100-10%,15V	56289	68D10444
A38C4275	290-0722-01			CAP.,FXD,ELCTLT:100UF,20%,10V	51984	NDK 107M10C
A38C4276	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A38C4306	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A38C4316	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A38C4317	283-0330-00			CAP.,FXD,CER DI:100PF,5%,50V	72982	8111N068C0G0101J
A38C4324	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A38C4328	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A38C4332	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A38C4334	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A38C4343	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A38C4345	290-0523-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0020HA1
A38C4347	283-0330-00			CAP.,FXD,CER DI:100PF,5%,50V	72982	8111N068C0G0101J
A38C4350	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	196D106X0025K
A38C4358	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A38C4368	290-0525-00			CAP.,FXD,ELCTLT:4.7UF,20%,50V	56289	196D475X0050KA1
A38C4369	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	273C5
A38C4373	290-0809-00			CAP.,FXD,ELCTLT:6.8UF,20%,50V	56289	196D685X0050PE4
A38C4377	290-0721-01			CAP.,FXD,ELCTLT:100UF,20%,20V	56289	196D107X0020T
A38C4381	290-0726-01			CAP.,FXD,ELCTLT:220UF,20%,10V	51984	NDM227M10C
A38C4382	290-0726-01			CAP.,FXD,ELCTLT:220UF,20%,10V	51984	NDM227M10C
A38C4383	290-0726-01			CAP.,FXD,ELCTLT:220UF,20%,10V	51984	NDM227M10C
A38C4387	290-0726-01			CAP.,FXD,ELCTLT:220UF,20%,10V	51984	NDM227M10C
A38C4388	290-0726-01			CAP.,FXD,ELCTLT:220UF,20%,10V	51984	NDM227M10C
A38C4389	290-0726-01			CAP.,FXD,ELCTLT:220UF,20%,10V	51984	NDM227M10C

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A38C4393	290-0721-01			CAP.,FXD,ELCTLT:100UF,20%,20V	56289	196D107X0020T
A38C4397	290-0809-00			CAP.,FXD,ELCTLT:6.8UF,20%,50V	56289	196D685X0050PE4
A38CR4120	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4121	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4122	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4131	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
A38CR4132	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
A38CR4140	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
A38CR4142	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
A38CR4151	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
A38CR4153	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
A38CR4168	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4169	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4170	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4173	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4175	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4176	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4177	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4178	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4185	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4186	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4187	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4188	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4189	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4191	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4192	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4204	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4206	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4235	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4260	152-0655-00			SEMICOND DEVICE:SILICON,100V,3A	03508	A115AX39
A38CR4282	152-0423-00			SEMICOND DEVICE:SILICON,400V,3A	04713	1N5000
A38CR4304	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4325	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4346	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4350	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4367	152-0075-00			SEMICOND DEVICE:GE,25V,40MA	14433	G866
A38CR4368	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A38CR4371	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
A38CR4372	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
A38CR4375	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
A38CR4376	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
A38CR4379	152-0198-02			SEMICOND DEVICE:SILICON,200V,3A	14099	SS4986
A38CR4380	152-0198-02			SEMICOND DEVICE:SILICON,200V,3A	14099	SS4986
A38CR4385	152-0198-02			SEMICOND DEVICE:SILICON,200V,3A	14099	SS4986
A38CR4386	152-0198-02			SEMICOND DEVICE:SILICON,200V,3A	14099	SS4986
A38CR4391	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
A38CR4392	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
A38CR4395	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
A38CR4396	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
A38DS4123	150-1036-00			LAMP,LED:RED,3.0V,40MA	01295	TIL 209A
A38DS4125	150-1036-00			LAMP,LED:RED,3.0V,40MA	01295	TIL 209A
A38F4301	159-0152-00			FUSE,WIRE LEAD:5A,125V,FAST BLOW	75915	275-005
A38K4260	148-0112-00			RELAY,ARMATURE:SPDT,6VDC,5A	94696	W65RPCX-1
A38Q4101	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
A38Q4111	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A38Q4124	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A38Q4125	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A38Q4126	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
A38Q4127	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
A38Q4128	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
A38Q4134	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A38Q4135	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
A38Q4136	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
A38Q4137	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A38Q4138	151-0407-00			TRANSISTOR:SILICON,NPN	04713	SS2456
A38Q4144	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A38Q4145	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
A38Q4146	151-0406-00			TRANSISTOR:SILICON,PNP	04713	OBD
A38Q4147	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A38Q4149	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A38Q4154	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A38Q4155	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A38Q4164	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A38Q4165	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A38Q4166	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A38Q4167	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A38Q4168	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A38Q4169	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A38Q4173	151-1121-00			TRANSISTOR:FE,N CHANNEL,SI,VN-3	000GU	N01003N3
A38Q4174	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A38Q4175	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A38Q4176	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A38Q4177	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
A38Q4178	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A38Q4179	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A38Q4184	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
A38Q4185	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
A38Q4186	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A38Q4189	151-1121-00			TRANSISTOR:FE,N CHANNEL,SI,VN-3	000GU	N01003N3
A38R4103	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
A38R4106	315-0625-00			RES.,FXD,CMPSN:6.2M OHM,5%,0.25W	01121	CB6255
A38R4107	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
A38R4110	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A38R4111	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
A38R4112	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A38R4115	315-0912-00			RES.,FXD,CMPSN:9.1K OHM,5%,0.25W	01121	CB9125
A38R4117	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
A38R4119	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
A38R4120	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
A38R4121	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
A38R4122	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
A38R4123	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A38R4124	315-0244-00			RES.,FXD,CMPSN:240K OHM,5%,0.25W	01121	CB2445
A38R4125	311-1222-00			RES.,VAR,NONWIR:100 OHM,20%,0.50W	32997	3386F-T04-101
A38R4126	311-1231-00			RES.,VAR,NONWIR:25K OHM,20%,0.50W	32997	3386F-T04-253
A38R4127	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
A38R4128	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A38R4129	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
A38R4130	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A38R4131	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A38R4133	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
A38R4134	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
A38R4135	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
A38R4136	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A38R4138	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A38R4139	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
A38R4141	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A38R4144	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
A38R4145	321-0142-00			RES.,FXD,FILM:294 OHM,1%,0.125W	91637	MFF1816G294R0F
A38R4147	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
A38R4149	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
A38R4150	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A38R4151	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A38R4161	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A38R4162	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A38R4164	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A38R4166	311-1223-00			RES.,VAR,NONWIR:TRMR,250 OHM,0.5W	02111	63M251T602
A38R4167	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
A38R4170	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A38R4172	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A38R4175	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
A38R4176	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
A38R4178	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
A38R4180	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A38R4182	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A38R4184	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
A38R4189	321-0420-00			RES.,FXD,FILM:232K OHM,1%,0.125W	91637	MFF1816G23202F
A38R4190	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A38R4191	321-0030-00			RES.,FXD,FILM:20 OHM,1%,0.125W	91637	MFF1816G20R00F
A38R4192	321-0030-00			RES.,FXD,FILM:20 OHM,1%,0.125W	91637	MFF1816G20R00F
A38R4193	321-0001-00			RES.,FXD,FILM:10 OHM,1%,0.125W	75042	CEAT0-10R00F
A38R4194	321-0152-00			RES.,FXD,FILM:374 OHM,1%,0.125W	91637	MFF1816G374R0F
A38R4195	321-0179-00			RES.,FXD,FILM:715 OHM,1%,0.125W	91637	MFF1816G715R0F
A38R4202	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
A38R4203	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A38R4204	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A38R4206	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A38R4208	315-0754-00			RES.,FXD,CMPSN:750K OHM,5%,0.25W	01121	CB7545
A38R4209	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
A38R4211	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
A38R4215	315-0913-00			RES.,FXD,CMPSN:91K OHM,5%,0.25W	01121	CB9135
A38R4217	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
A38R4218	307-0573-00			RES NTWK,FXD FI:(9)100K,(11)200K OHM,2%	01121	314 L10104
A38R4220	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A38R4222	321-0352-00			RES.,FXD,FILM:45.3K OHM,1%,0.125W	91637	MFF1816G45301F
A38R4223	321-0363-00			RES.,FXD,FILM:59K OHM,1%,0.125W	91637	MFF1816G59001F
A38R4225	321-0365-00			RES.,FXD,FILM:61.9K OHM,1%,0.125W	91637	MFF1816G61901F
A38R4226	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
A38R4227	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A38R4230	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
A38R4231	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A38R4233	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A38R4260	301-0240-00			RES.,FXD,CMPSN:24 OHM,5%,0.50W	01121	EB2405
A38R4261	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
A38R4264	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A38R4266	315-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625
A38R4273	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A38R4274	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
A38R4276	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
A38R4278	321-0224-00			RES.,FXD,FILM:2.1K OHM,1%,0.125W	91637	MFF1816G21000F
A38R4280	308-0822-00			RES.,FXD,WW:1.3 OHM,5%,2W	75042	BWF 1.3 OHM 5%

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A38R4281	315-0160-00			RES.,FXD,CMPSN:16 OHM,5%,0.25W	01121	CB1605
A38R4282	301-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.50W	01121	EB7505
A38R4283	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A38R4301	321-0149-00			RES.,FXD,FILM:348 OHM,1%,0.125W	91637	MFF1816G348R0F
A38R4303	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
A38R4305	321-0272-07			RES.,FXD,FILM:6.65K OHM,0.1%,0.125W	91637	MFF1816C66500B
A38R4306	321-0924-07			RES.,FXD,FILM:40K OHM,0.1%,0.125W	91637	MFF1816C40001B
A38R4308	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
A38R4309	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
A38R4310	321-0370-00			RES.,FXD,FILM:69.8K OHM,1%,0.125W	91637	MFF1816G69801F
A38R4312	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A38R4313	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A38R4315	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A38R4316	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A38R4317	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A38R4319	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A38R4320	321-0228-09			RES.,FXD,FILM:2.32K OHM,1%,0.125W	91637	MFF1816C23200F
A38R4321	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
A38R4322	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
A38R4323	321-0228-09			RES.,FXD,FILM:2.32K OHM,1%,0.125W	91637	MFF1816C23200F
A38R4325	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A38R4327	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A38R4329	321-0289-07			RES.,FXD,FILM:10K OHM,0.1%,0.125W	91637	MFF1816C10001B
A38R4330	321-0924-07			RES.,FXD,FILM:40K OHM,0.1%,0.125W	91637	MFF1816C40001B
A38R4332	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
A38R4334	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A38R4336	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
A38R4338	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A38R4339	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
A38R4341	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A38R4343	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
A38R4344	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A38R4345	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A38R4346	321-0820-06			RES.,FXD,FILM:42K OHM,0.25%,0.125W	91637	MFF1816C42001C
A38R4347	321-0281-07			RES.,FXD,FILM:8.25K OHM,0.10%,0.125W	91637	MFF1816C82500B
A38R4348	321-0396-00			RES.,FXD,FILM:130K OHM,1%,0.125W	91637	MFF1816G13002F
A38R4350	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A38R4351	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A38R4353	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
A38R4355	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A38R4357	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A38R4360	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A38R4365	321-0816-07			RES.,FXD,FILM:5K OHM,0.1%,0.125W	91637	MFF1816C50000B
A38R4366	321-1296-07			RES.,FXD,FILM:12K OHM,0.1%,0.125W	91637	MFF1816C12001B
A38R4368	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A38R4369	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
A38R4373	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
A38R4375	307-0104-00			RES.,FXD,CMPSN:3.3 OHM,5%,0.25W	01121	CB33G5
A38R4377	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
A38R4392	307-0104-00			RES.,FXD,CMPSN:3.3 OHM,5%,0.25W	01121	CB33G5
A38R4397	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
A38S3730	260-1771-00			SWITCH,PUSH:DPDT,1 BUTTON,2 POLE	80009	260-1771-00
A38T4300	120-1342-00			XFMR,PWR,SDN&SU:HF,POT CORE	80009	120-1342-00
A38TP4142	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A38TP4165	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A38TP4186	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A38TP4377	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A38TP4383	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A38TP4384	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A38TP4389	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A38TP4393	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A38U4121	156-1152-01			MICROCIRCUIT,DI:PRCN RETRIGGERABLE,BURN-IN	80009	156-1152-01
A38U4122	156-0494-02			MICROCIRCUIT,DI:HEX INV/BUFF,SELECTED	80009	156-0494-02
A38U4123	156-0067-13			MICROCIRCUIT,LI:OPNL AMPL,SELECTED	04713	MC1741CUDS
A38U4124	156-1152-01			MICROCIRCUIT,DI:PRCN RETRIGGERABLE,BURN-IN	80009	156-1152-01
A38U4126	156-1266-01			MICROCIRCUIT,LI:OVERVOLTAGE SENSING CIRCUIT	80009	156-1266-01
A38U4132	156-0349-06			MICROCIRCUIT,DI:QUAD 2 INP NOR GATE,CHK	80009	156-0349-06
A38U4133	156-0644-03			MICROCIRCUIT,DI:QUAD BILATERAL SW,BURN-IN	04713	MC14066BCLD
A38U4134	156-0366-02			MICROCIRCUIT,DI:DUAL D FLIP-FLOP,CHK	80009	156-0366-02
A38U4136	156-0158-03			MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
A38U4141	156-0752-01			MICROCIRCUIT,DI:DUAL BCD UP COUNTER,SCRN	04713	MC14518BCLD
A38U4142	156-0579-02			MICROCIRCUIT,DI:DUAL 4 BIT BIN COUNTER,SEL	80009	156-0579-02
A38U4143	156-0895-01			MICROCIRCUIT,DI:14 BIT BINARYCNTR,BURN-IN	04713	MC14020BCLD
A38U4144	156-0545-01			MICROCIRCUIT,DI:12 BIT BINARYCNTR,SCRN	04713	MC14040BCLD
A38U4145	156-0067-13			MICROCIRCUIT,LI:OPNL AMPL,SELECTED	04713	MC1741CUDS
A38U4146	156-0545-01			MICROCIRCUIT,DI:12 BIT BINARYCNTR,SCRN	04713	MC14040BCLD
A38U4151	156-0349-03			MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE,SEL	80009	156-0349-03
A38U4153	156-0575-03			MICROCIRCUIT,DI:3 INPUT NOR GATE,SELECTED	80009	156-0575-03
A38U4155	156-0105-02			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER,SEL	01295	LM301AJG4
A38U4156	156-0495-02			MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
A38U4165	156-1439-00			MICROCIRCUIT,LI:VOLTAGE REF	04713	MC1403AUDS
A38VR4282	152-0438-00			SEMICOND DEVICE:ZENER,3W,9.1V,5%	12969	UZ1364
A38VR4332	152-0149-00			SEMICOND DEVICE:ZENER,0.4W,10V,5%	04713	SZG35009K3
A38Y4100	158-0204-00			XTAL UNIT,QTZ:400KHZ,0.01%	00815	NE-33D

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A39	----- -----			CKT BOARD ASSY:SWEEP SWITCH		
A39R4242	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A39R4243	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A39S3740	260-1883-00			SWITCH,PUSH:2 POLE,2 BTN,ALARM/DELAY	80009	260-1883-00
A39S3750	260-1883-00			SWITCH,PUSH:2 POLE,2 BTN,ALARM/DELAY	80009	260-1883-00
A39S4250	260-1213-00			SWITCH,PUSH:DPDT,1A,28VDC	80009	260-1213-00
A39S4350	260-1771-00			SWITCH,PUSH:DPDT,1 BUTTON,2 POLE	80009	260-1771-00
A40	----- -----			CKT BOARD ASSY:HIGH VOLTAGE		
A40C4446	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
A40C4421	283-0280-00			CAP.,FXD,CER DI:2200PF,10%,2000V	56289	562CBA202EH222KA
A40C4422	283-0280-00			CAP.,FXD,CER DI:2200PF,10%,2000V	56289	562CBA202EH222KA
A40C4423	283-0280-00			CAP.,FXD,CER DI:2200PF,10%,2000V	56289	562CBA202EH222KA
A40C4424	283-0280-00			CAP.,FXD,CER DI:2200PF,10%,2000V	56289	562CBA202EH222KA
A40C4425	283-0280-00			CAP.,FXD,CER DI:2200PF,10%,2000V	56289	562CBA202EH222KA
A40C4426	283-0280-00			CAP.,FXD,CER DI:2200PF,10%,2000V	56289	562CBA202EH222KA
A40C4461	283-0006-00			CAP.,FXD,CER DI:0.02UF,+80-20%,500V	72982	0841545Z5V00203Z
A40C4463	283-0006-00			CAP.,FXD,CER DI:0.02UF,+80-20%,500V	72982	0841545Z5V00203Z
A40CR4443	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A40CR4445	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
A40CR4421	152-0170-00			SEMICOND DEVICE:SILICON,1500V,10UA	80009	152-0170-00
A40CR4422	152-0170-00			SEMICOND DEVICE:SILICON,1500V,10UA	80009	152-0170-00
A40CR4423	152-0170-00			SEMICOND DEVICE:SILICON,1500V,10UA	80009	152-0170-00
A40CR4424	152-0170-00			SEMICOND DEVICE:SILICON,1500V,10UA	80009	152-0170-00
A40CR4425	152-0170-00			SEMICOND DEVICE:SILICON,1500V,10UA	80009	152-0170-00
A40CR4426	152-0170-00			SEMICOND DEVICE:SILICON,1500V,10UA	80009	152-0170-00
A40CR4446	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A40CR4451	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A40CR4452	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A40CR4453	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A40CR4454	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A40CR4455	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A40CR4456	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A40CR4461	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
A40CR4463	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
A40Q4442	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
A40Q4446	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A40R4442	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A40R4443	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A40R4444	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A40R4421	315-0225-00			RES.,FXD,CMPSN:2.2M OHM,5%,0.25W	01121	CB2255
A40R4431	315-0225-00			RES.,FXD,CMPSN:2.2M OHM,5%,0.25W	01121	CB2255
A40R4432	315-0225-00			RES.,FXD,CMPSN:2.2M OHM,5%,0.25W	01121	CB2255
A40R4433	315-0225-00			RES.,FXD,CMPSN:2.2M OHM,5%,0.25W	01121	CB2255
A40R4434	315-0225-00			RES.,FXD,CMPSN:2.2M OHM,5%,0.25W	01121	CB2255
A40R4437	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
A40R4440	311-1255-00			RES.,VAR,NONWIR:2M OHM,20%,0.50W	73138	72-19-0
A40R4454	315-0475-00			RES.,FXD,CMPSN:4.7M OHM,5%,0.25W	01121	CB4755
A40R4455	315-0106-00			RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
A40R4456	315-0106-00			RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
A40R4461	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
A40R4463	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				CHASSIS PARTS		
BT1	119-1318-00			BATTERY SET:F CELLS,CONDITIONING	80009	119-1318-00
C5341	283-0211-00			CAP.,FXD,CER DI:0.1UF,10%,200V	72982	8141N210X7R0104K
C5342	283-0211-00			CAP.,FXD,CER DI:0.1UF,10%,200V	72982	8141N210X7R0104K
C5343	283-0211-00			CAP.,FXD,CER DI:0.1UF,10%,200V	72982	8141N210X7R0104K
CR4191	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4193	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4195	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR5423	152-0668-00			SEMICOND DEVICE:RECT BRIDGE,SI,200V,6A	80009	152-0668-00
CR5424	152-0668-00			SEMICOND DEVICE:RECT BRIDGE,SI,200V,6A	80009	152-0668-00
DS4050	150-1070-00			LT EMITTING DIO:RED,635NM,35AMAX	50522	MV57124
DS4060	150-1070-00			LT EMITTING DIO:RED,635NM,35AMAX	50522	MV57124
DS4070	150-1070-00			LT EMITTING DIO:RED,635NM,35AMAX	50522	MV57124
DS4080	150-1070-00			LT EMITTING DIO:RED,635NM,35AMAX	50522	MV57124
DS5312	150-1078-00			LT EMITTING DIO:GREEN,565NM,20MA	50434	HLMP 1502
DS5322	150-1078-00			LT EMITTING DIO:GREEN,565NM,20MA	50434	HLMP 1502
DS5420	150-1089-01			LAMP,LED:GREEN,565NM,24V,W/CONN	80009	150-1089-01
F5421	159-0025-00			FUSE,CARTRIDGE:3AG,0.5A,250V,FAST-BLOW	71400	AGC 1/2
J5300	131-1378-01			CONNECTOR,RCPT:5 CONTACT	80009	131-1378-01
J5340	131-1376-00			CONNECTOR,RCPT,:4 CONTACT	81312	M43-LRN
J5345	131-1375-00			CONN,RCPT,ELEC:FLANGE MT,6 CONT,FEMALE	02660	MS3102A
J5361	131-1863-00			JACK,TELEPHONE:STD 0.25,5 COND DBL-CL CKT	82389	114B
J5362	131-1863-00			JACK,TELEPHONE:STD 0.25,5 COND DBL-CL CKT	82389	114B
J5410	131-1862-00			JACK,TELEPHONE:STANDARD 0.25,3 CONDUCTOR	82389	112B
J5412	131-1862-00			JACK,TELEPHONE:STANDARD 0.25,3 CONDUCTOR	82389	112B
J5414	131-1862-00			JACK,TELEPHONE:STANDARD 0.25,3 CONDUCTOR	82389	112B
J5420	131-1084-02			CONN,RCPT,ELEC:PWR,MALE,250VAC,6A	82389	EAC 301
L5420	119-0950-00			COIL,TUBE DEFL:CRT YOKE	80009	119-0950-00
LS5419	119-0716-01			LOUDSPEAKER,PM:W/CABLE	80009	119-0716-01
Q4139	151-0414-00			TRANSISTOR:SILICON,PNP	04713	MJE1092
Q4158	151-0477-00			TRANSISTOR:SILICON,NPN	01295	EP1425
Q4159	151-0477-00			TRANSISTOR:SILICON,NPN	01295	EP1425
R5310	311-2073-00			RES.,VAR,NONWIR:20K OHM,10%,0.5W	01121	WAIG036S203UZ
R5320	311-2074-00			RES.,VAR,NONWIR:PNL MTG,20K OHM,10%,0.5W	12697	CM41756
R5344	311-2088-00			RES.,VAR,NONWIR:PNL,2 X 10K OHM,10%,1W	12697	CM41760
R5350	311-1298-00	B010100	C010269	RES.,VAR,NONWIR:10K OHM,20%,0.50W	01121	W-7909
R5350	311-2132-00	C010270		RES.,VAR,NONWIR:PNL,10K OHM,20%	02111	64W104T010
R5415	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R5416	311-2072-00			RES.,VAR,NONWIR:100K OHM,20%,0.5W	01121	WAIG032S104MZ
R5418	311-2072-00			RES.,VAR,NONWIR:100K OHM,20%,0.5W	01121	WAIG032S104MZ
RT5420	----- -----			(SEE L5420)		
S5364	260-1812-00			SWITCH,SLIDE:DPDT,0.5A,125VAC/VDC	82389	11P-1076
S5420	260-1967-00			SWITCH,SLIDE:DPDT,5A/250V,10A/125V MKD	000FJ	4021.0512
T5420	120-1294-00			XFMR,PWR,STPDN:LF	80009	120-1294-00
V5440	154-0508-01			ELECTRON TUBE:CRT	S0482	CT 496 BP7

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols

Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975.

Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The overline on a signal name indicates that the signal performs its intended function when it is in the low state.

Abbreviations are based on ANSI Y1.1-1972.

Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

Y14.15, 1966	Drafting Practices.
Y14.2, 1973	Line Conventions and Lettering.
Y10.5, 1968	Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.

American National Standard Institute
1430 Broadway
New York, New York 10018

Component Values

Electrical components shown on the diagrams are in the following units unless noted otherwise:

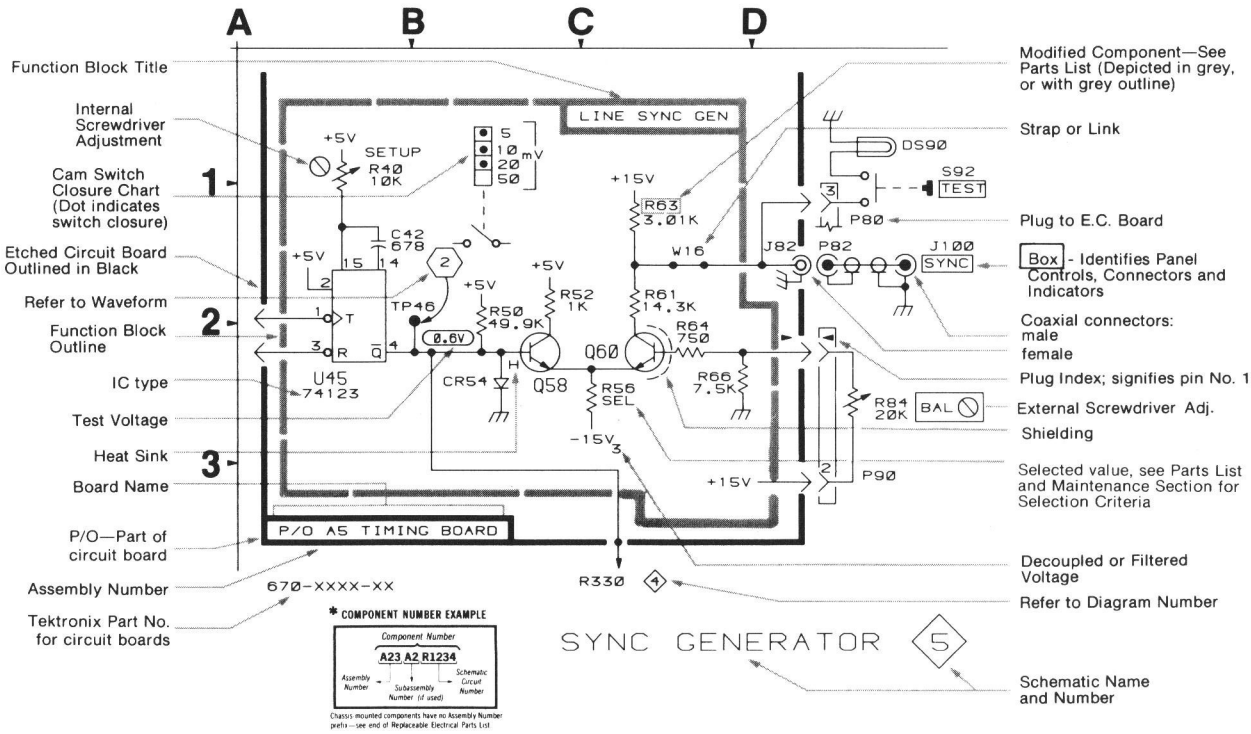
Capacitors = Values one or greater are in picofarads (pF). Values less than one are in microfarads (μF).
Resistors = Ohms (Ω).

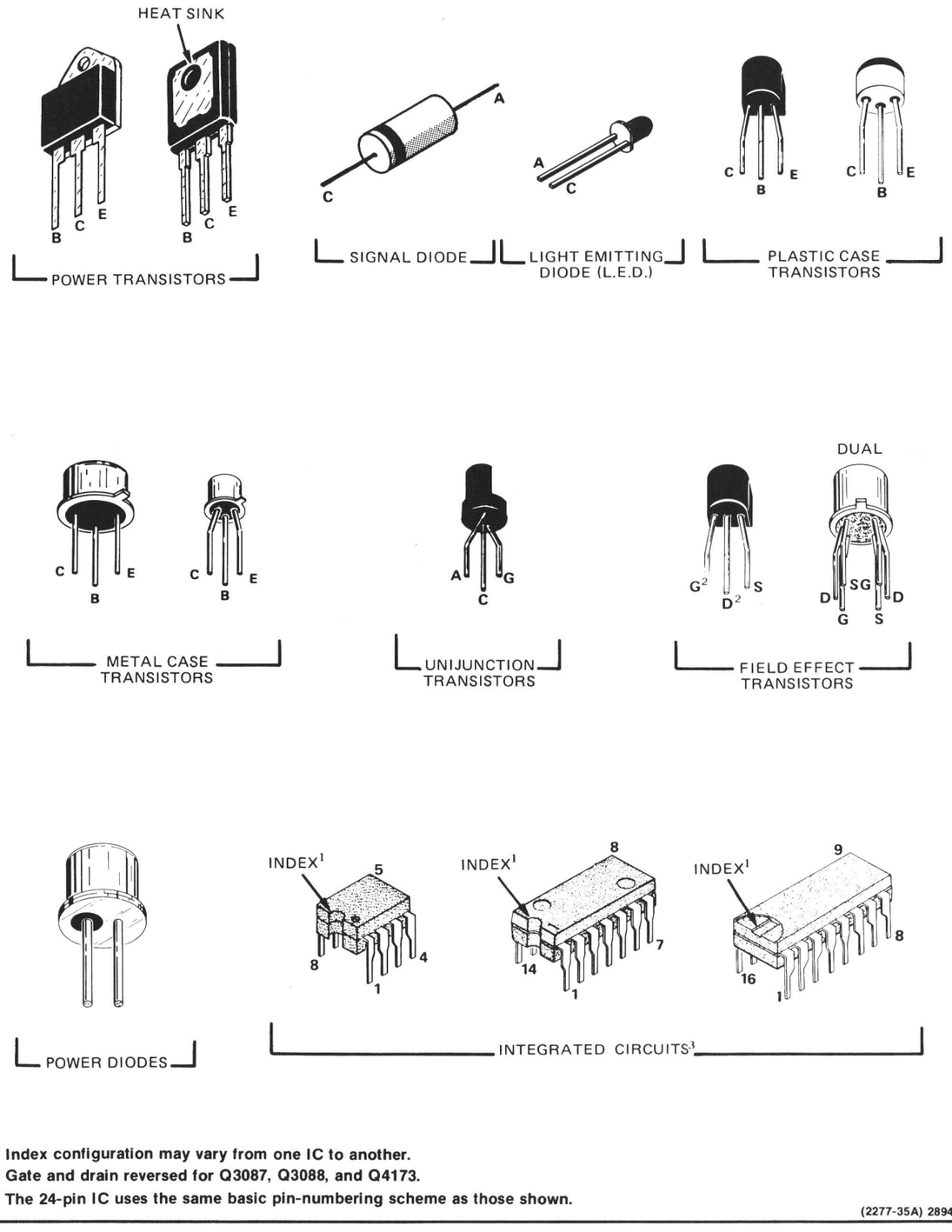
The information and special symbols below may appear in this manual.

Assembly Numbers and Grid Coordinates

Each assembly in the instrument is assigned an assembly number (e.g., A20). The assembly number appears on the circuit board outline on the diagram, in the title for the circuit board component location illustration, and in the lookup table for the schematic diagram and corresponding component locator illustration. The Replaceable Electrical Parts list is arranged by assemblies in numerical sequence; the components are listed by component number *(see following illustration for constructing a component number).

The schematic diagram and circuit board component location illustration have grids. A lookup table with the grid coordinates is provided for ease of locating the component. Only the components illustrated on the facing diagram are listed in the lookup table. When more than one schematic diagram is used to illustrate the circuitry on a circuit board, the circuit board illustration may only appear opposite the first diagram on which it was illustrated; the lookup table will list the diagram number of other diagrams that the circuitry of the circuit board appears on.

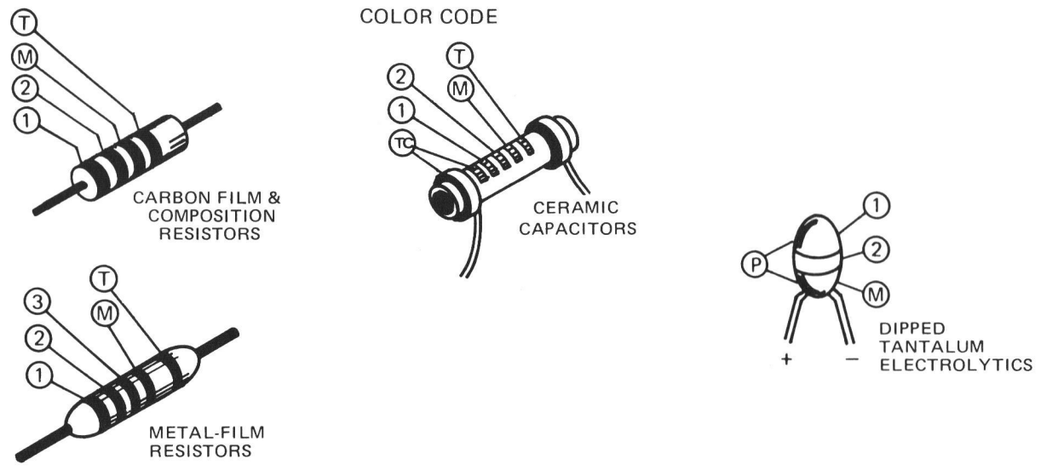




[1] Index configuration may vary from one IC to another.
[2] Gate and drain reversed for Q3087, Q3088, and Q4173.
[3] The 24-pin IC uses the same basic pin-numbering scheme as those shown.

(2277-35A) 2894-50

Fig. 8-1. Semiconductor lead configurations.



(1) (2) and (3) - 1ST, 2ND, AND 3RD SIGNIFICANT FIGS. (T) AND/OR (TC) COLOR CODE MAY NOT BE PRESENT ON SOME CAPACITORS;
(M) - MULTIPLIER (T) - TOLERANCE;
(TC) - TEMPERATURE COEFFICIENT. (P) - POLARITY AND VOLTAGE RATING

COLOR	SIGNIFICANT FIGURES	RESISTORS		CAPACITORS			DIPPED TANTALUM VOLTAGE RATING
		MULTIPLIER (OHMS)	TOLERANCE	MULTIPLIER (pF)	TOLERANCE OVER 10pF	TOLERANCE UNDER 10pF	
BLACK	0	1	---	1	±20%	± 2pF	4VDC
BROWN	1	10	±1%	10	±1%	±0.1pF	6VDC
RED	2	10^2 or 100	±2%	10^2or 100	±2%	---	10VDC
ORANGE	3	10^3or 1 K	±3%	10^3 or 1000	±3%	---	15VDC
YELLOW	4	10^4 or 10K	±4%	10^4 or 10,000	+100% −0%	---	20VDC
GREEN	5	10^5 or 100 K	±1/2%	10^5or 100,000	±5%	±0.5pF	25VDC
BLUE	6	10^6 or 1 M	±1/4%	10^6 or 1,000,000	---	---	35VDC
VIOLET	7	---	±1/10%	10^7 or 10,000,000	---	---	50VDC
GRAY	8	---	---	10^{-2} or 0.01	+80% −20%	±0.25pF	---
WHITE	9	---	---	10^{-1} or 0.1	±10%	±1pF	3VDC
GOLD	---	10^{-1} or 0.1	±5%	---	---	---	---
SILVER	---	10^{-2} or 0.01	±10%	---	---	---	---
NONE	---	---	±20%	---	±10%	±1pF	---

(1862-74) 2894-49

Fig. 8-2. Color-code component value identification.

Symbol Definitions

1	High Level	X	Don't Care	⌐‾	High-To-Low Transition
0	Low Level	⌐‾	Low-To-High Transition	CL	Clock Level Change
⌐‾⌐	One High Level Pulse				
‾⌐‾	One Low Level Pulse				

4013 (156-0366-00) DUAL 'D' TYPE FLIP-FLOP

CL▲	D	R	S	Q	$\overline{Q}$	
⌐‾	0	0	0	0	1	
⌐‾	1	0	0	1	0	
‾⌐	X	0	0	Q	$\overline{Q}$	NO CHANGE
X	X	1	0	0	1	
X	X	0	1	1	0	
X	X	1	1	1	1	

4015B DUAL 4-STAGE STATIC SHIFT REGISTER

CL	D	R	Q_t	Q_n	
⌐‾	0	0	0	Q_{n-1}	
⌐‾	1	0	1	Q_{n-1}	
‾⌐	X	0	Q_t	Q_n	(NO CHANGE)
X	X	1	0	0	

4022B OCTAL COUNTER/DRIVER

CLOCK	CLOCK ENABLE	RESET	OUTPUT−n
0	X	0	n
X	1	0	n
⌐‾	0	0	n + 1
‾⌐	X	0	n
1	‾⌐	0	n + 1
X	⌐‾	0	n
X	X	1	Q0

If n < 4 Carry =1, Otherwise = 0

4028 (156-0756-00) BCD-to-DECIMAL DECODER

D	C	B	A	0	1	2	3	4	5	6	7	8	9
0	0	0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	1	0	1	0	0	0	0	0	0	0	0
0	0	1	0	0	0	1	0	0	0	0	0	0	0
0	0	1	1	0	0	0	1	0	0	0	0	0	0
0	1	0	0	0	0	0	0	1	0	0	0	0	0
0	1	0	1	0	0	0	0	0	1	0	0	0	0
0	1	1	0	0	0	0	0	0	0	1	0	0	0
0	1	1	1	0	0	0	0	0	0	0	1	0	0
1	0	0	0	0	0	0	0	0	0	0	0	1	0
1	0	0	1	0	0	0	0	0	0	0	0	0	1

4042B QUAD LATCH

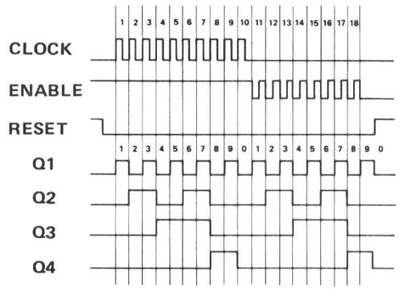
CLOCK	POLARITY	Q
0	0	Data
⌐‾	0	Latch
1	1	Data
‾⌐	1	Latch

4051 (156-0513-00) MULTIPLEXER/DEMULTIPLEXER

INPUT STATES				"ON" CHANNELS
INHIBIT	C	B	A	
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	X	X	X	NONE

4518 (156-0752-00) DUAL UP COUNTERS

CLOCK	ENABLE	RESET	ACTION
⌐‾	1	0	Increment Counter
0	‾⌐	0	Increment Counter
‾⌐	X	0	No Change
X	⌐‾	0	No Change
⌐‾	0	0	No Change
1	‾⌐	0	No Change
X	X	1	Q1 thru Q4 = 0



DM8880 (156-0284-00) DECODER/DRIVER

DECIMAL OR FUNCTION	RB1	D	C	B	A	B1/RB0	a	b	c	d	e	f	g	DISPLAY
0	1	0	0	0	0	1	0	0	0	0	0	0	1	0
1	X	0	0	0	1	1	1	0	0	1	1	1	1	1
2	X	0	0	1	0	1	0	0	1	0	0	1	0	2
3	X	0	0	1	1	1	0	0	0	0	1	1	0	3
4	X	0	1	0	0	1	1	0	0	1	1	0	0	4
5	X	0	1	0	1	1	0	1	0	0	1	0	0	5
6	X	0	1	1	0	1	0	1	0	0	0	0	0	6
7	X	0	1	1	1	1	0	0	0	1	1	1	1	7
8	X	1	0	0	0	1	0	0	0	0	0	0	0	8
9	X	1	0	0	1	1	0	0	0	0	1	0	0	9
10	X	1	0	1	0	1	0	0	0	1	0	0	0	A
11	X	1	0	1	1	1	1	1	0	0	0	0	0	b
12	X	1	1	0	0	1	0	1	1	0	0	0	1	C
13	X	1	1	0	1	1	1	0	0	0	0	1	0	d
14	X	1	1	1	0	1	0	1	1	0	0	0	0	E
15	X	1	1	1	1	1	0	1	1	1	0	0	0	F
B1	X	X	X	X	X	0	1	1	1	1	1	1	1	
RB1	0	0	0	0	0	0	1	1	1	1	1	1	1	

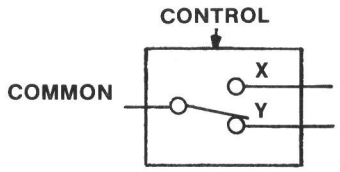
(SYMBOL IDENTIFICATION)

Fig. 8-3. 413A IC truth tables.

MORE

4053

CONTROL	ON CHANNEL
0	X
1	Y



4538B
DUAL RETRIGGERABLE RESETTABLE MONOSTABLE MULTIVIBRATOR

$\overline{I_0}$	I_1	$\overline{C_D}$	OPERATION
H→L	L	H	Trigger
H	L→H	H	Trigger
X	X	L	Reset

4555B
DUAL BINARY TO 1-OF-4 DECODER/DEMULTIPLEXER

INPUTS			OUTPUTS			
ENABLE	SELECT					
E	B	A	Q_3	Q_2	Q_1	Q_0
0	0	0	0	0	0	1
0	0	1	0	0	1	0
0	1	0	0	1	0	0
0	1	1	1	0	0	0
1	X	X	0	0	0	0

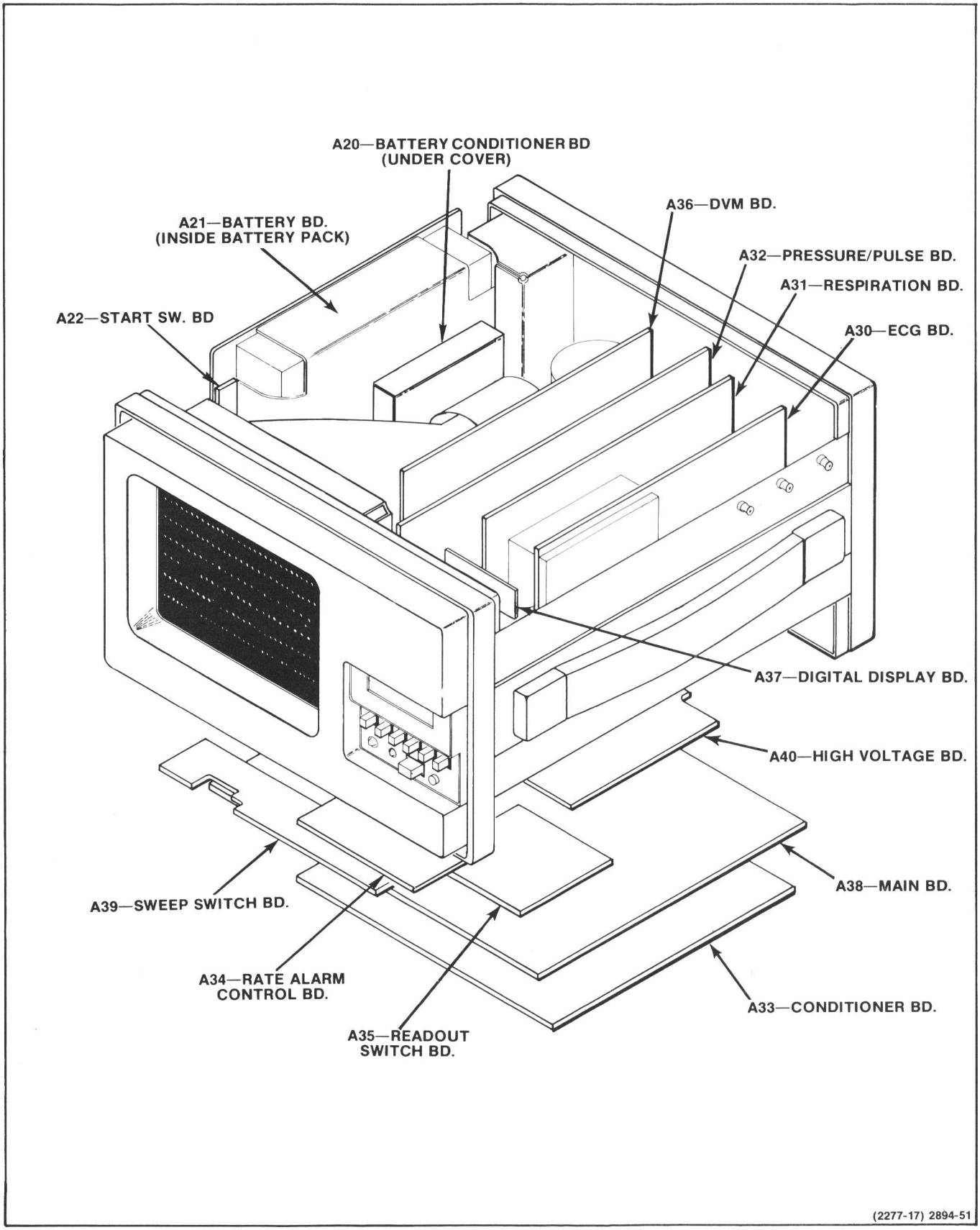
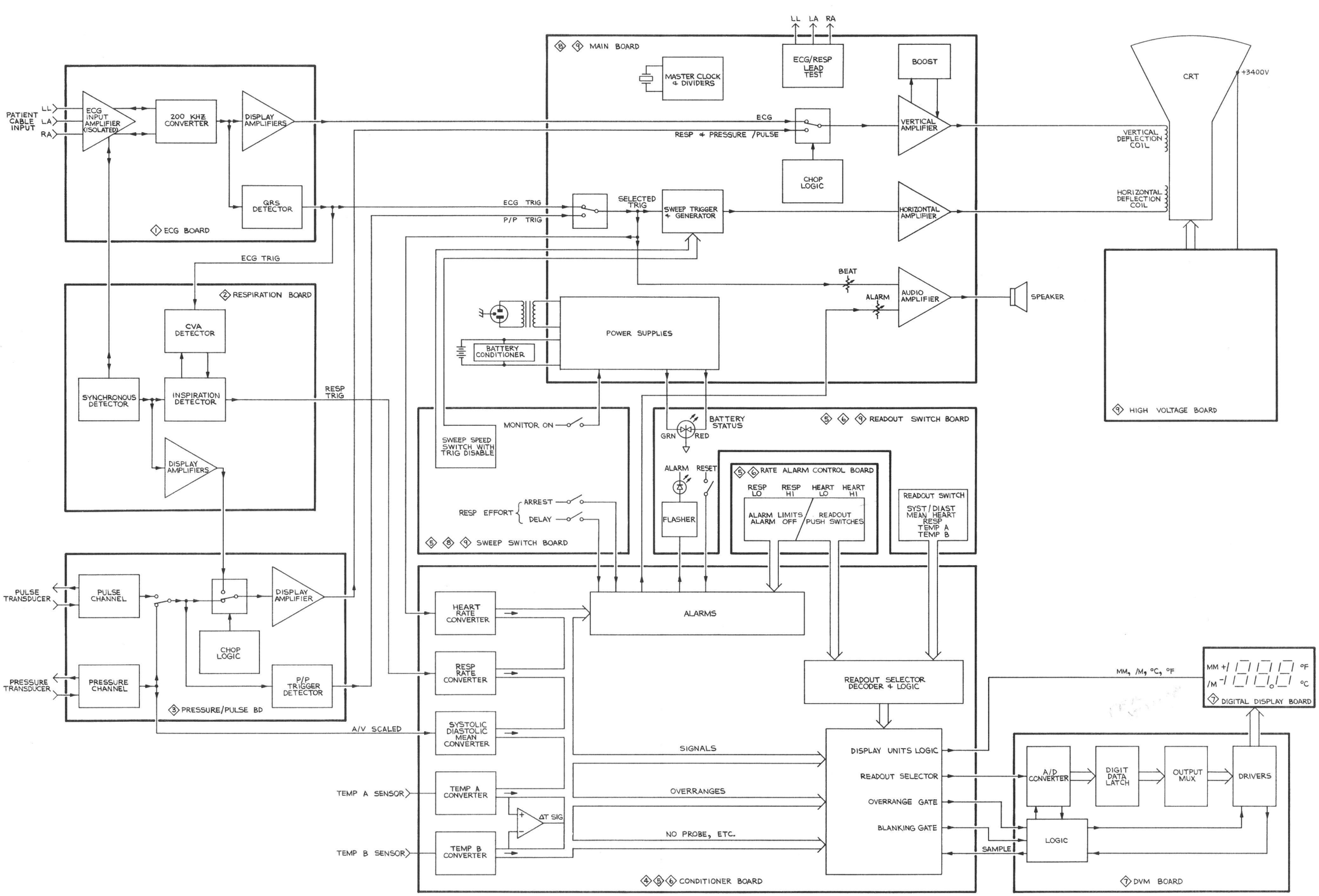


Fig. 8-4. Circuit board locations.



413A

2894-80
@

FUNCTIONAL BLOCK DIAGRAM

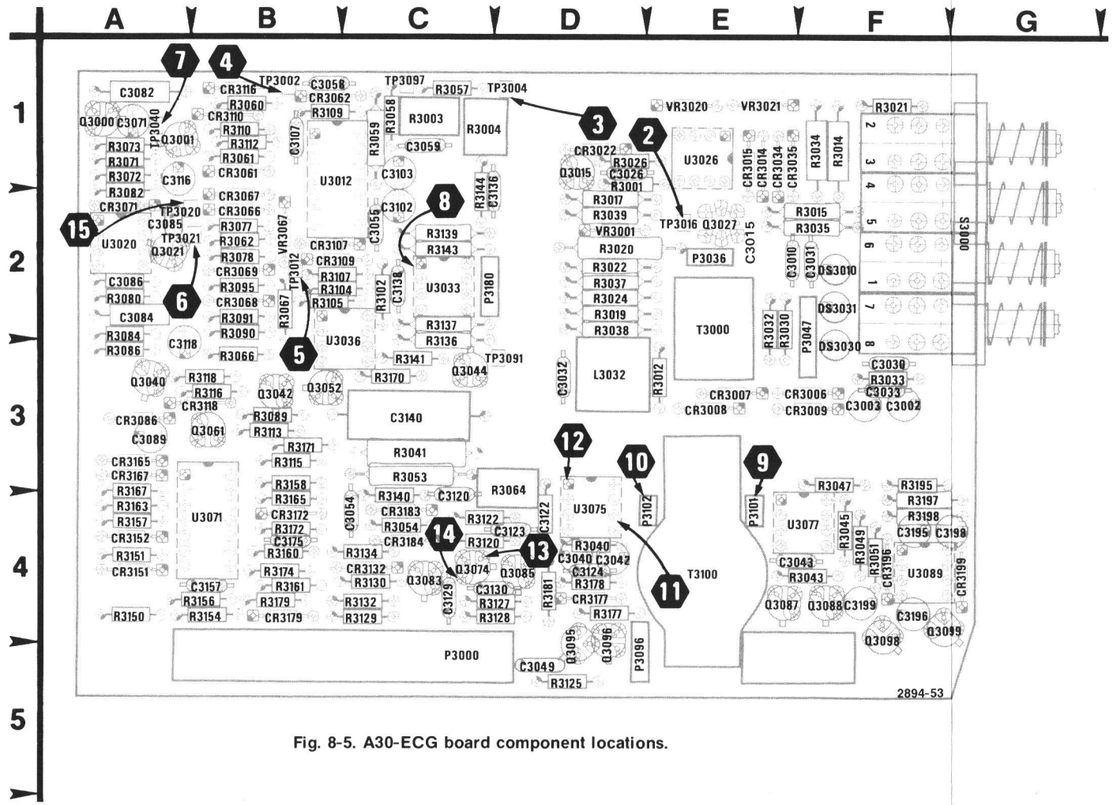
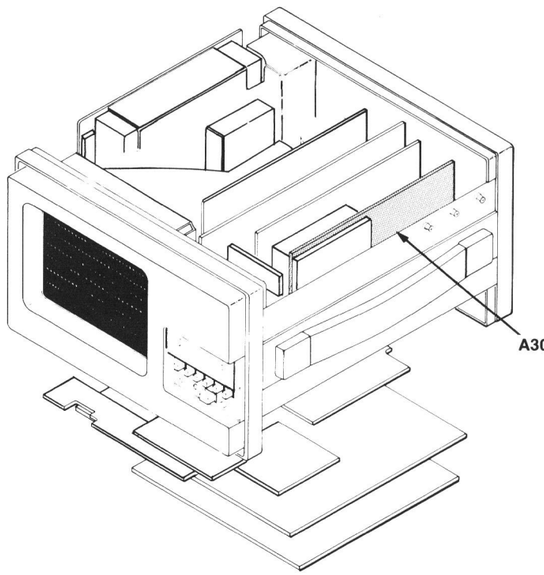


Fig. 8-5. A30-ECG board component locations.



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number

A23 A2 R1234

Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

ECG DIAGRAM

ASSEMBLY A30

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C3002	C1	F3	CR3006	C1	F3	P3000	G5	C5
C3003	C1	F3	CR3007	C1	E3	P3000	H2	C5
C3010	A2	F2	CR3008	C1	E3	P3036	A3	E2
C3015	C2	E2	CR3009	C1	F3	P3047	A2	F2
C3026	C2	D1	CR3014	C2	E1	P3096	D1	D5
C3030	A2	F3	CR3015	C2	E1	P3101	E1	E4
C3031	A3	F2	CR3022	C2	D1	P3102	E1	E4
C3032	B3	D3	CR3034	C3	E1	P3180	G4	C2
C3033	A3	F3	CR3035	C3	E1			
C3040	D1	D4	CR3061	F1	B1	Q3000	G2	A1
C3042	D1	D4	CR3062	F2	B1	Q3001	G2	A1
C3043	D1	F4	CR3066	F2	B2	Q3015	C2	D1
C3049	F1	D5	CR3067	F2	B2	Q3021	G2	A2
C3054	D2	C4	CR3068	F2	B2	Q3027A	C2	E2
C3055	D2	C2	CR3069	F2	B2	Q3027B	C3	E2
C3058	E2	B1	CR3071	F2	A2	Q3040	F2	A3
C3059	E2	C1	CR3086	H2	A3	Q3042	E2	B3
C3071	G1	A1	CR3107	E2	C2	Q3044	D5	C3
C3082	G2	A1	CR3109	E2	B2	Q3052	E2	B3
C3084	G2	A2	CR3110	E2	B1	Q3061	H2	B3
C3085	H2	A2	CR3116	E3	B1	Q3074	E3	C4
C3086	H2	A2	CR3118	F2	B3	Q3083	F3	C4
C3089	G2	A3	CR3132	F3	C4	Q3085	E3	D4
C3102	D3	C2	CR3151	B4	A4	Q3087	E1	E4
C3103	D3	C1	CR3152	B4	A4	Q3088	E1	F4
C3107	E2	B1	CR3165	F5	A3	Q3095	D5	D5
C3116	E3	A1	CR3167	G5	A3	Q3096	D5	D5
C3118	F2	A3	CR3172	D5	B4	Q3098	C3	F4
C3120	D3	C4	CR3177	D5	D4	Q3099	C4	F4
C3122	D3	D4	CR3179	D5	B4			
C3123	D3	D4	CR3183	E5	C4	R3003	D3	C1
C3124	D3	D4	CR3184	E5	C4	R3004	E4	C1
C3129	E3	C4	CR3196	C3	F4	R3012	B2	E3
C3130	E3	C4	CR3199	C4	G4	R3014	B2	F1
C3136	E4	C2				R3015	B2	F2
C3138	D3	C2	DS3010	A2	F2	R3017	C2	D2
C3140	D4	C3	DS3030	A2	F3	R3019	C2	D2
C3157	F4	B4	DS3031	A3	F2	R3020	C2	D2
C3175	D5	B4				R3021	B2	F1
C3195	B3	F4	L3032	B2	D3	R3022	C2	D2
C3196	C3	F4				R3024	C2	D2
C3198	C4	F4	P3000	B4	C5	R3026	C2	D1
C3199	C4	F4	P3000	E1	C5	R3030	B2	E2

Partial A30 also shown on diagram 8.

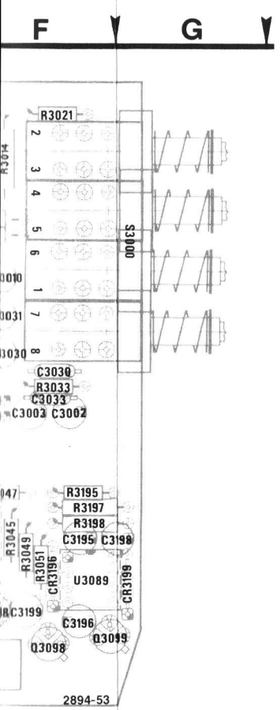
ASSEMBLY A33

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P2400	H4	C1	P3600	H4	A4			

Partial A33 also shown on diagrams 2, 3, 4, 5, 6 and 9.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS5312	H2	CHASSIS	J5300	A2	CHASSIS	P5300	A3	CHASSIS



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number

A23 A2 R1234

Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis mounted components have no Assembly Number (i.e., see end of Replaceable Electrical Parts List).

ECG DIAGRAM 1

ASSEMBLY A30

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C3002	C1	F3	CR3006	C1	F3	P3000	G5	C5	R3032	B3	E2	R3110	E2	B1	R3198	C4	F4
C3003	C1	F3	CR3007	C1	E3	P3000	H2	C5	R3033	A3	F3	R3112	E2	B1			
C3010	A2	F2	CR3008	C1	E3	P3036	A3	E2	R3034	B3	F1	R3113	E2	B3	S3000	C1	G2
C3015	C2	E2	CR3009	C1	F3	P3047	A2	F2	R3035	B3	F2	R3115	F2	B3			
C3026	C2	D1	CR3014	C2	E1	P3096	D1	D5	R3037	C3	D2	R3116	F2	B3	T3000	B3	E2
C3030	A2	F3	CR3015	C2	E1	P3101	E1	E4	R3038	C3	D2	R3118	F2	B3	T3100	D1	E4
C3031	A3	F2	CR3022	C2	D1	P3102	E1	E4	R3039	C3	D2	R3120	D3	C4			
C3032	B3	D3	CR3034	C3	E1	P3180	G4	C2	R3040	D1	D4	R3122	D3	C4	TP3002	D2	B1
C3033	A3	F3	CR3035	C3	E1				R3041	D2	C3	R3125	E3	D5	TP3004	D2	D1
C3040	D1	D4	CR3061	F1	B1	Q3000	G2	A1	R3043	D1	F4	R3127	E3	C4	TP3012	F1	B2
C3042	D1	D4	CR3062	F2	B1	Q3001	G2	A1	R3045	E1	F4	R3128	E3	C4	TP3016	C2	E2
C3043	D1	F4	CR3066	F2	B2	Q3015	C2	D1	R3047	E1	F3	R3129	E3	C4	TP3020	G3	A2
C3049	F1	D5	CR3067	F2	B2	Q3021	G2	A2	R3049	F1	F4	R3130	E3	C4	TP3021	G2	A2
C3054	D2	C4	CR3068	F2	B2	Q3027A	C2	E2	R3051	F1	F4	R3132	F3	C4	TP3040	H2	A1
C3055	D2	C2	CR3069	F2	B2	Q3027B	C3	E2	R3053	D2	C3	R3134	F3	C4	TP3091	C3	D3
C3058	E2	B1	CR3071	F2	A2	Q3040	F2	A3	R3054	D2	C4	R3136	D3	C3	TP3097	C4	C1
C3059	E2	C1	CR3086	H2	A3	Q3042	E2	B3	R3057	E1	C1	R3137	D3	C2			
C3071	G1	A1	CR3107	E2	C2	Q3044	D5	C3	R3058	E2	C1	R3139	D3	C2	U3012A	E1	C1
C3082	G2	A1	CR3109	E2	B2	Q3052	E2	B3	R3059	E2	C1	R3140	D4	C4	U3012B	E2	C1
C3084	G2	A2	CR3110	E2	B1	Q3061	H2	B3	R3060	E2	B1	R3141	D4	C3	U3012C	D2	C1
C3085	H2	A2	CR3116	E3	B1	Q3074	E3	C4	R3061	E2	B1	R3143	D4	C2	U3012D	E2	C1
C3086	H2	A2	CR3118	F2	B3	Q3083	F3	C4	R3062	F2	B2	R3144	E4	C2	U3020	G2	A2
C3089	G2	A3	CR3132	F3	C4	Q3085	E3	D4	R3064	D2	D4	R3150	B4	A4	U3026A	C2	E1
C3102	D3	C2	CR3151	B4	A4	Q3087	E1	E4	R3066	F2	B3	R3151	B4	A4	U3026B	C2	E1
C3103	D3	C1	CR3152	B4	A4	Q3088	E1	F4	R3067	F2	B2	R3154	C4	B4	U3033A	D3	C2
C3107	E2	B1	CR3165	F5	A3	Q3095	D5	D5	R3071	F1	A1	R3156	F4	B4	U3033B	D4	C2
C3116	E3	A1	CR3167	G5	A3	Q3096	D5	D5	R3072	G1	A1	R3157	F4	A4	U3036	D2	C3
C3118	F2	A3	CR3172	D5	B4	Q3098	C3	F4	R3073	G2	A1	R3158	G4	B3	U3071A	G5	B4
C3120	D3	C4	CR3177	D5	D4	Q3099	C4	F4	R3077	F2	B2	R3160	G4	B4	U3071B	F4	B4
C3122	D3	D4	CR3179	D5	B4				R3078	F2	B2	R3161	G5	B4	U3071C	F4	B4
C3123	D3	D4	CR3183	E5	C4	R3003	D3	C1	R3080	G2	A2	R3163	G5	A4	U3071D	D5	B4
C3124	D3	D4	CR3184	E5	C4	R3004	E4	C1	R3082	G2	A2	R3165	F5	B4	U3075A	D3	D4
C3129	E3	C4	CR3196	C3	F4	R3012	B2	E3	R3084	G2	A3	R3167	G5	A4	U3075B	D2	D4
C3130	E3	C4	CR3199	C4	G4	R3014	B2	F1	R3086	H2	A3	R3170	D5	C3	U3077A	E1	F4
C3136	E4	C2				R3015	B2	F2	R3089	H2	B3	R3171	D5	B3	U3077B	E1	F4
C3138	D3	C2	DS3010	A2	F2	R3017	C2	D2	R3090	F2	B2	R3172	D5	B4	U3089A	C3	F4
C3140	D4	C3	DS3030	A2	F3	R3019	C2	D2	R3091	F2	B2	R3174	E5	B4	U3089B	C4	F4
C3157	F4	B4	DS3031	A3	F2	R3020	C2	D2	R3095	G2	B2	R3177	D5	D4			
C3175	D5	B4				R3021	B2	F1	R3102	D3	C2	R3178	D5	D4	VR3001	B1	D2
C3195	B3	F4	L3032	B2	D3	R3022	C2	D2	R3104	D2	B2	R3179	D5	B4	VR3020	C2	E1
C3196	C3	F4				R3024	C2	D2	R3105	D3	B2	R3181	D5	D4	VR3021	C2	E1
C3198	C4	F4	P3000	B4	C5	R3026	C2	D1	R3107	E2	B2	R3195	B3	F3	VR3067	F2	B2
C3199	C4	F4	P3000	E1	C5	R3030	B2	E2	R3109	E2	B1	R3197	C4	F4			

Partial A30 also shown on diagram 8.

ASSEMBLY A33

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P2400	H4	C1	P3600	H4	A4			

Partial A33 also shown on diagrams 2, 3, 4, 5, 6 and 9.

ASSEMBLY A38

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
CR4175	H2	B5	P4171 P4172	H2 H4	B7 B7	R4175	H2	B6

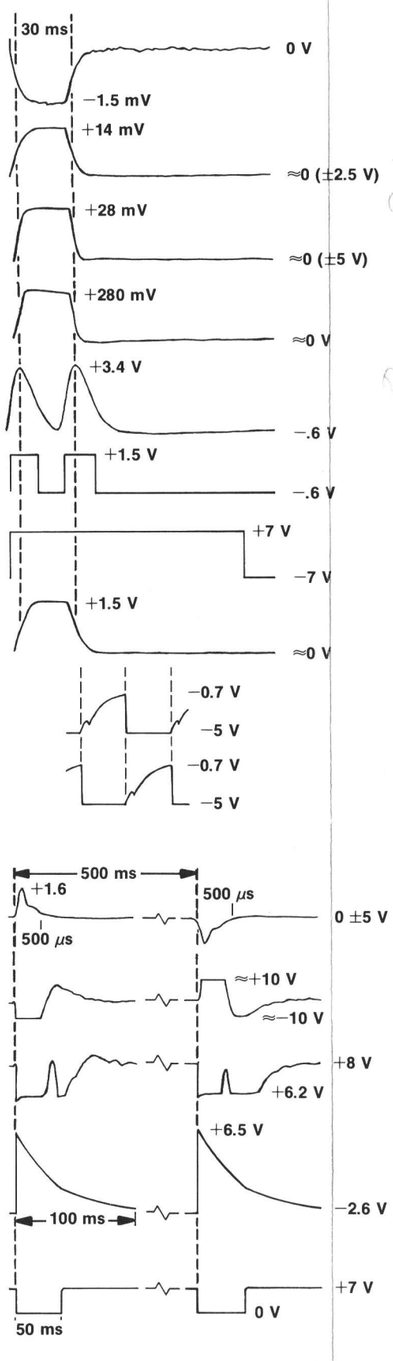
Partial A38 also shown on diagrams 2, 3, 4, 5, 6, 7, 8 and 9.

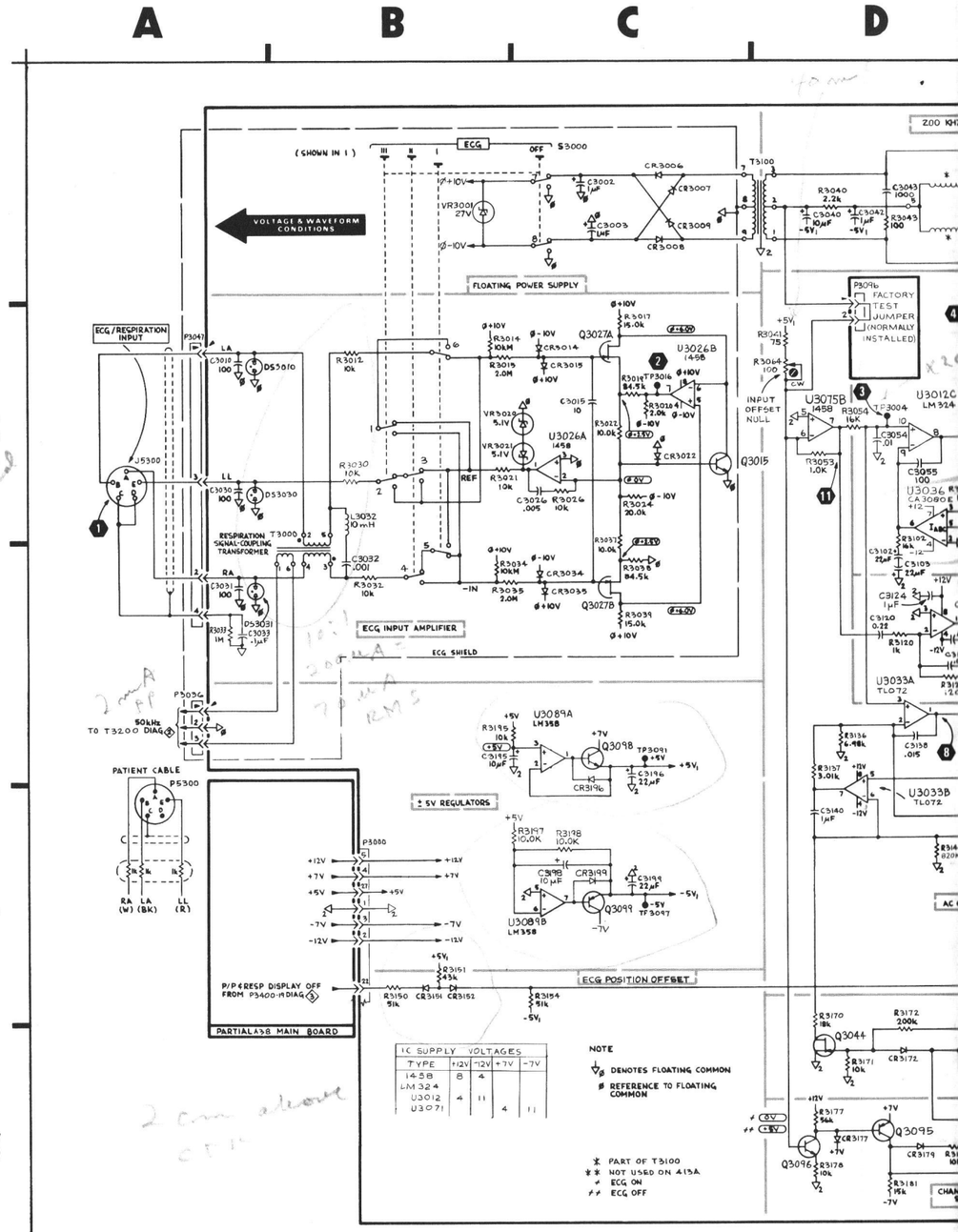
CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS5312	H2	CHASSIS	J5300	A2	CHASSIS	P5300	A3	CHASSIS	R5310	H4	CHASSIS			

ECG ①

WAVEFORM NUMBER	DESCRIPTION	CONDITIONS	IDEALIZED WAVEFORM
1	ECG LEAD TEST WAVEFORM	ECG/RESP LEAD TEST CONNECTED TO ECG/RESPIRATION PATIENT CABLE INPUT	
2	TP3016 ECG INPUT AMPLIFIER	ABOVE PLUS ECG LEAD SELECTOR: II	
3	TP3004 CURRENT TO VOLTAGE CONVERTER (FILTERED)	ABOVE	
4	TP3002 QRS VARIABLE GAIN AMPLIFIER	ABOVE	
5	TP3012 QRS DIFFERENTATOR + ABSOLUTE VALUE DETECTOR	ABOVE	
6	TP3021 QRS TIMER INPUT	ABOVE	
7	TP3040 QRS TIMER OUTPUT	ABOVE	
8	U3033A PIN 1 ECG OUTPUT (X1000)	ABOVE	
9	P3101 200 kHz CONVERTER		
10	P3102 200 kHz CONVERTER		
11	U3075B PIN 7 PACER DETECTOR INPUT	0.5 V 1 Hz Square Wave APPLIED TO 413A ECG/RESP LEAD TEST RA TERMINAL THROUGH 0.47 μF. ECG/RESP LEAD TEST APPLIED TO ECG/RESP INPUT	
12	U3075A PIN 1 PACER DETECTOR	ABOVE	
13	Q3074—GATE PACER DETECTOR	ABOVE	
14	Q3074—CATHODE PACER DETECTOR	ABOVE	
15	TP 3020 QRS DISABLE	ABOVE	





413A

ED WAVEFORM

0 V

5 mV

mV

≈0 (±2.5 V)

mV

≈0 (±5 V)

0 mV

≈0 V

4 V

−.6 V

1.5 V

−.6 V

+7 V

−7 V

V

≈0 V

−0.7 V

−5 V

−0.7 V

−5 V

ns

500 μs

0 ±5 V

≈+10 V

≈−10 V

+8 V

+6.2 V

+6.5 V

−2.6 V

+7 V

0 V

A B C D E F G H

1 2 3 4 5

(SHOWN IN 1)

ECG

OFF

S3000

VOLTAGE & WAVEFORM CONDITIONS

FLOATING POWER SUPPLY

ECG/RESPIRATION INPUT

RESPIRATION SIGNAL-COUPLING TRANSFORMER

ECG INPUT AMPLIFIER

ECG SHIELD

50kHz TO T3200 DIAG

PATIENT CABLE

RA (W) (BK) LA (R) LL

± 5V REGULATORS

P/P4 RESP DISPLAY OFF FROM P3400-19 DIAG

PARTIAL A38 MAIN BOARD

ECG POSITION OFFSET

200 KHZ CONVERTER

FACTORY TEST JUMPER (NORMALLY INSTALLED)

INPUT OFFSET NULL

PACER DETECTOR

GAIN

DC LEVEL

AC COUPLED AMPLIFIER

QRS DET DISABLE

TRACE RECOVERY

CHANNEL OFF SENSE

QRS DETECTOR

QRS DISABLE

DISPLAY AMPLIFIERS

BANDWIDTH LIMIT

UPPER { INSTALLED 50Hz / REMOVED 100Hz

LOWER { INSTALLED 0.5Hz / REMOVED 0.2Hz

ECG SIZE

ECG WAVE (0.25 V/cm) TO U4135B-4 DIAG

-ECG WAVE

P2400 OPTIONAL (TO RECORDER)

PARTIAL A35 CONDITIONER BD

ECG TRIG TO P3200-23 DIAG

(GRN) QRS

(QRS) ECG TRIG TO U4133C-8 DIAG

ECG OUTPUT (X1000) TO P4113-1 DIAG

PARTIAL A38 MAIN BD

LEAD FAULT TO CR4178 DIAG

TO P3400-20

TO P3200-24

ECG OFF TO U4122F-14 DIAG

ECG OFF

A30 ECG BOARD

PART A38 MAIN BOARD

IC SUPPLY VOLTAGES

TYPE	+12V	-12V	+7V	-7V
1458	8	4		
LM324				
U3012	4	11		
U3071			4	11

NOTE

▽ DENOTES FLOATING COMMON

REFERENCE TO FLOATING COMMON

* PART OF T3100

** NOT USED ON 413A

+ ECG ON

++ ECG OFF

COMPONENT NUMBER EXAMPLE

Component Number: A23 A2 R1234

Assembly Number - Subassembly Number (if used) + Schematic Circuit Number

Chassis mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List

Static Sensitive Devices — See Maintenance Section

413A

2894-81

REV A FEB 1981

ECG 1

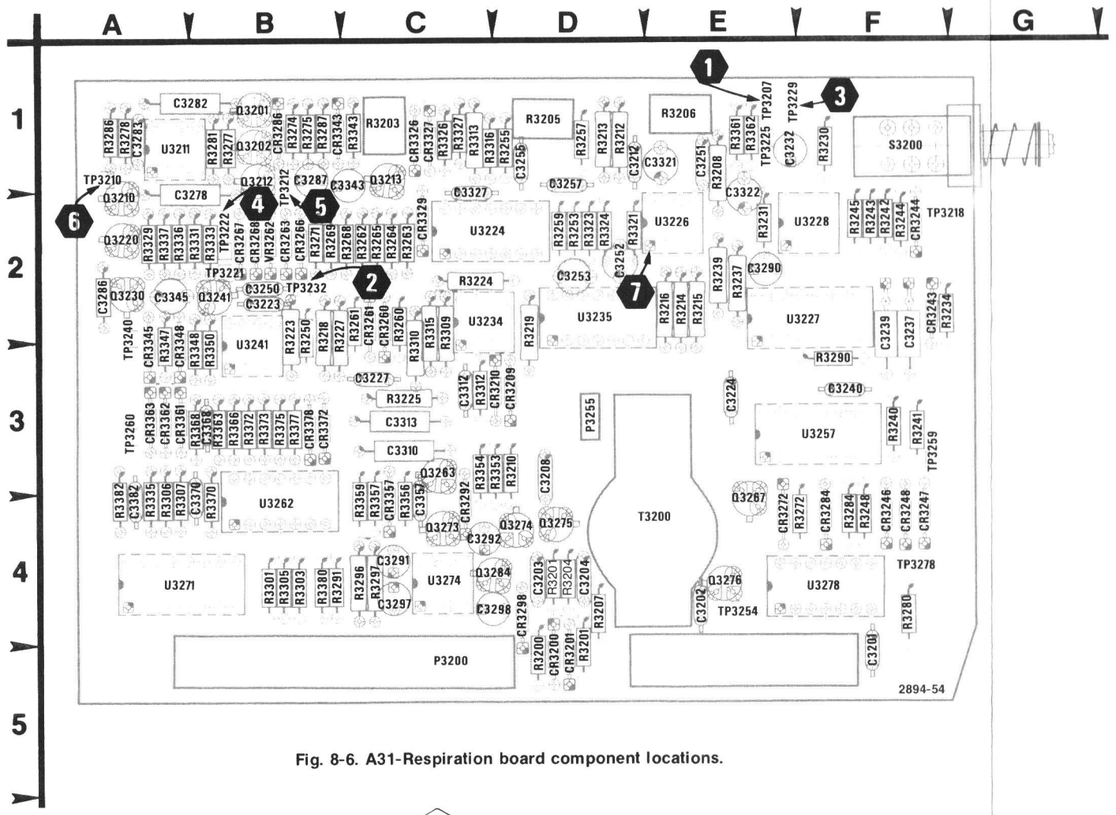
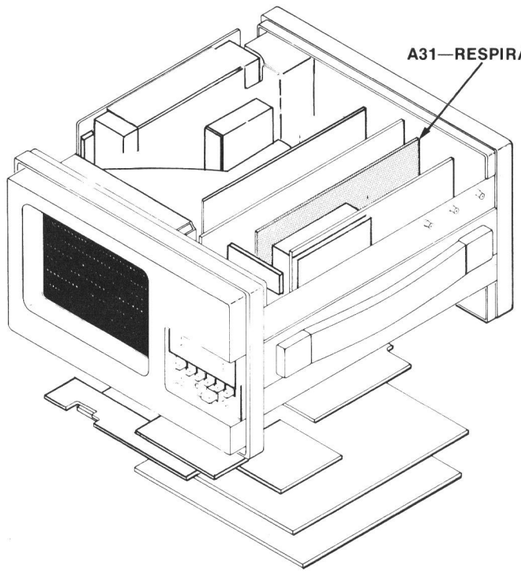
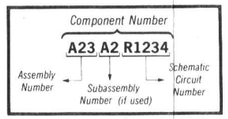


Fig. 8-6. A31-Respiration board component locations.



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

RESPIRATION DIAGRAM 2

ASSEMBLY A31

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C3201	A3	F5
C3202	A3	E4
C3203	B2	D4
C3204	B2	D4
C3208	B2	D3
C3212	C3	D1
C3223	D2	B2
C3224	C2	E3
C3227	D2	C3
C3232	D1	E1
C3237	E1	F2
C3239	E1	F2
C3240	F1	F3
C3248	F2	F4
C3250	D2	B2
C3251	D2	E1
C3252	D2	D2
C3253	D2	D2
C3255	E2	D1
C3257	E2	D1
C3278	G3	A2
C3282	G3	A1
C3283	G2	A1
C3286	G2	A2
C3287	G3	B1
C3290	A4	E2
C3291	B3	C4
C3292	B3	C4
C3297	B4	C4
C3298	B4	C4
C3310	D4	C3
C3312	D4	C3
C3313	D4	C3
C3321	D3	E1
C3322	D3	E1
C3327	E3	C2
C3343	F3	C1
C3345	E3	A2
C3357	E5	C4
C3368	F4	B3
C3370	F5	B3
C3382	F4	A4
CR3200	A2	D5
CR3201	A2	D5
CR3209	B2	D3
CR3210	B2	C3
CR3243	F1	F2
CR3244	E1	F2
CR3246	F1	F4
CR3247	F1	F4
CR3260	E2	C2
CR3261	E2	C2
CR3263	F2	B2
CR3266	F2	B2
CR3267	F2	B2
CR3268	F2	B2
CR3272	G2	E4
CR3284	H3	F4
CR3286	G3	B1
CR3292	B3	C4
CR3298	B4	D4
CR3326	D3	C1
CR3327	D3	C1
CR3329	E3	C2
CR3343	F3	B1
CR3345	E3	A3
CR3348	E3	A3
CR3357	D5	C4
CR3361	E5	A3
CR3362	E5	A3
CR3363	E5	A3
CR3372	F5	B3
CR3378	G5	B3
P3200	A2	C5
P3200	D1	C5
P3200	G4	C5
P3200	H1	C5
P3200	H2	C5
P3255	A2	D3
Q3201	F3	B1
Q3202	G3	B1
Q3210	G2	A2
Q3212	F2	B1
Q3213	F2	C1
Q3220	E3	A2
Q3230	E3	A2
Q3241	F3	B2
Q3263	D5	C3
Q3267	G2	E4
Q3273	B3	C4
Q3274	B2	D4
Q3275	B2	D4
Q3276	A5	E4
Q3284	B4	C4
R3200	A2	D5
R3201	A2	D4
R3202	B2	D4
R3203	E4	C1
R3204	B2	D4
R3205	D4	D1
R3206	C3	E1
R3207	B1	D4
R3208	B2	E1
R3210	B2	D3
R3212	C3	D1
R3213	C3	D1
R3214	C2	E2
R3215	C2	E2
R3216	C2	E2
R3218	C2	B2
R3219	C2	D2
R3223	D2	B2
R3224	C2	C2
R3225	C2	C3
R3227	C2	B2
R3230	D1	F1
R3231	D1	E2
R3234	D1	G2
R3237	E1	E2
R3239	E1	E2
R3240	F1	F3
R3241	F1	F3
R3242	E1	F2
R3243	E1	E2
R3244	E1	E2
R3245	F1	F2
R3247	F1	F4
R3248	F1	F4
R3250	D2	B2
R3253	E2	E2
R3255	E2	E2
R3257	E2	E2
R3259	E2	E2
R3260	E2	C2
R3261	E2	C2
R3262	F2	B2
R3263	F2	B2
R3264	F2	B2
R3265	F2	B2
R3268	F2	B2
R3269	F2	C1
R3271	F2	B2
R3272	G2	E2
R3274	G2	E2
R3284	H3	E2
R3286	G3	E2
R3287	G3	E2
R3290	A4	E2
R3292	B3	C4
R3296	B4	C4
R3297	B4	C4
R3301	D4	C3
R3303	D4	C3
R3306	C5	B4
R3307	C5	D4
R3309	D4	D4
R3310	D4	D4
R3312	D4	D4
R3313	D4	D4
R3315	D4	D4

ASSEMBLY A33

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P2400	H4	C1

Partial A33 also shown on diagrams 1, 3, 4, 5, 6 and 9.

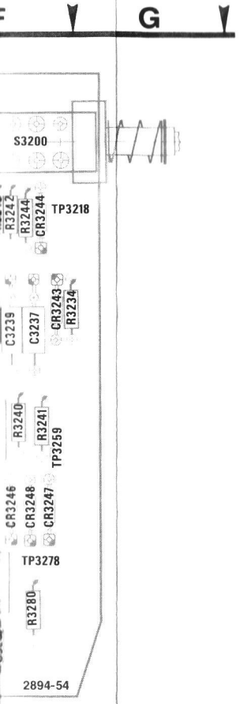
ASSEMBLY A38

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P3600	G4	A4
CR4176	H2	C6
P4193	G4	
P4193	G5	

Partial A38 also shown on diagrams 1, 3, 4, 5, 6, 7, 8 and 9.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS5322	H2	CHASSIS
R5320	H4	CHASSIS
S5320	H5	CHASSIS



Static Sensitive Devices
See Maintenance Section

NENT NUMBER EXAMPLE

Component Number

A23 A2 R1234

Subassembly Number (if used)

Schematic Circuit Number

nd components have no Assembly Number
nd of Replaceable Electrical Parts List

RESPIRATION DIAGRAM 2

ASSEMBLY A31

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C3201	A3	F5
C3202	A3	E4
C3203	B2	D4
C3204	B2	D4
C3208	B2	D3
C3212	C3	D1
C3223	D2	B2
C3224	C2	E3
C3227	D2	C3
C3232	D1	E1
C3237	E1	F2
C3239	E1	F2
C3240	F1	F3
C3248	F2	F4
C3250	D2	B2
C3251	D2	E1
C3252	D2	D2
C3253	D2	D2
C3255	E2	D1
C3257	E2	D1
C3278	G3	A2
C3282	G3	A1
C3283	G2	A1
C3286	G2	A2
C3287	G3	B1
C3290	A4	E2
C3291	B3	C4
C3292	B3	C4
C3297	B4	C4
C3298	B4	C4
C3310	D4	C3
C3312	D4	C3
C3313	D4	C3
C3321	D3	E1
C3322	D3	E1
C3327	E3	C2
C3343	F3	C1
C3345	E3	A2
C3357	E5	C4
C3368	F4	B3
C3370	F5	B3
C3382	F4	A4
CR3200	A2	D5
CR3201	A2	D5
CR3209	B2	D3
CR3210	B2	C3
CR3243	F1	F2
CR3244	E1	F2
CR3246	F1	F4
CR3247	F1	F4
CR3260	E2	C2
CR3261	E2	C2
CR3263	F2	B2
CR3266	F2	B2
CR3267	F2	B2
CR3268	F2	B2
CR3272	G2	E4
CR3284	H3	F4
CR3286	G3	B1
CR3292	B3	C4
CR3298	B4	D4
CR3326	D3	C1
CR3327	D3	C1
CR3329	E3	C2
CR3343	F3	B1
CR3345	E3	A3
CR3348	E3	A3
CR3357	D5	C4
CR3361	E5	A3
CR3362	E5	A3
CR3363	E5	A3
CR3372	F5	B3
CR3378	G5	B3
P3200	A2	C5
P3200	D1	C5
P3200	G4	C5
P3200	H1	C5
P3200	H2	C5
P3255	A2	D3
Q3201	F3	B1
Q3202	G3	B1
Q3210	G2	A2
Q3212	F2	B1
Q3213	F2	C1
Q3220	E3	A2
Q3230	E3	A2
Q3241	F3	B2
Q3263	D5	C3
Q3267	G2	E4
Q3273	B3	C4
Q3274	B2	D4
Q3275	B2	D4
Q3276	A5	E4
Q3284	B4	C4
R3200	A2	D5
R3201	A2	D4
R3202	B2	D4
R3203	E4	C1
R3204	B2	D4
R3205	D4	D1
R3206	C3	E1
R3207	B1	D4
R3208	B2	E1
R3210	B2	D3
R3212	C3	D1
R3213	C3	D1
R3214	C2	E2
R3215	C2	E2
R3216	C2	E2
R3218	C2	B2
R3219	C2	D2
R3223	D2	B2
R3224	C2	C2
R3225	C2	C3
R3227	C2	B2
R3230	D1	F1
R3231	D1	E2
R3234	D1	G2
R3237	E1	E2
R3239	E1	E2
R3240	F1	F3
R3241	F1	F3
R3242	E1	F2
R3243	E1	F2
R3244	E1	F2
R3245	F1	F2
R3248	F2	F4
R3250	D2	B2
R3253	E2	D2
R3255	E2	D1
R3257	E2	D1
R3259	E2	D2
R3260	E2	C2
R3261	E2	C2
R3262	F2	C2
R3263	F2	C2
R3264	F2	C2
R3265	F2	C2
R3268	F2	C2
R3269	F2	B2
R3271	F2	B2
R3272	G2	F4
R3274	F3	B1
R3275	F3	B1
R3277	G2	B1
R3278	G3	A1
R3280	G2	F4
R3281	G2	B1
R3284	H3	F4
R3286	G3	A1
R3287	G3	B1
R3290	A4	F3
R3291	B3	B4
R3296	B3	C4
R3297	B3	C4
R3301	B4	B4
R3303	B4	B4
R3305	B4	B4
R3306	C5	A4
R3307	C5	A4
R3309	D4	C2
R3310	D4	C2
R3312	D4	C3
R3313	D4	C1
R3315	D4	C2
R3316	E4	C1
R3321	D3	D2
R3323	D3	D2
R3324	D3	D2
R3326	E3	C1
R3327	E3	C1
R3329	E3	A2
R3331	E3	B2
R3333	E3	B2
R3335	F4	A4
R3336	E3	A2
R3337	E3	A2
R3343	F3	C1
R3347	E3	A3
R3348	F3	B2
R3350	F3	B2
R3353	D5	C3
R3354	D5	C3
R3356	D5	C4
R3357	D5	C4
R3359	E5	C4
R3361	A5	E1
R3362	B5	E1
R3363	E5	B3
R3366	F4	B3
R3368	F4	B3
R3370	F5	B3
R3372	F5	B3
R3373	G5	B3
R3375	G5	B3
R3377	G5	B3
R3380	G4	B4
R3382	G4	A4
S3200	F5	F1
T3200	B1	E4
TP3207	B2	E1
TP3210	G2	A1
TP3212	F2	B1
TP3218	F1	F2
TP3221	F3	B2
TP3222	F2	B2
TP3225	D2	E1
TP3229	E1	E1
TP3232	D2	B2
TP3240	E3	A2
TP3254	B4	E4
TP3259	E1	F3
TP3260	B3	A3
TP3278	G2	F4
U3211	G2	A1
U3224A	E2	C2
U3224B	D2	C2
U3224C	E2	C2
U3224D	E3	C2
U3226	D3	E2
U3227A	E1	F2
U3227B	E1	F2
U3228A	D1	F2
U3228B	F1	F2
U3234A	D4	C2
U3234B	D4	C2
U3235	C2	D2
U3241A	F4	B2
U3241B	D2	B2
U3257A	F1	F3
U3257B	G1	F3
U3262A	F5	B4
U3262B	E5	B4
U3262C	G5	B4
U3271	C4	A4
U3274A	B4	C4
U3274B	B3	C4
U3278A	F1	F4
U3278B	F1	F4
U3278C	F2	F4
U3278D	E2	F4
VR3262	F2	B2

ASSEMBLY A33

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P2400	H4	C1
P3600	G4	A4

Partial A33 also shown on diagrams 1, 3, 4, 5, 6 and 9.

ASSEMBLY A38

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
CR4176	H2	C6
P4193	G4	C7
P4193	G5	C7
P4193	H2	C7
R4176	H2	D7

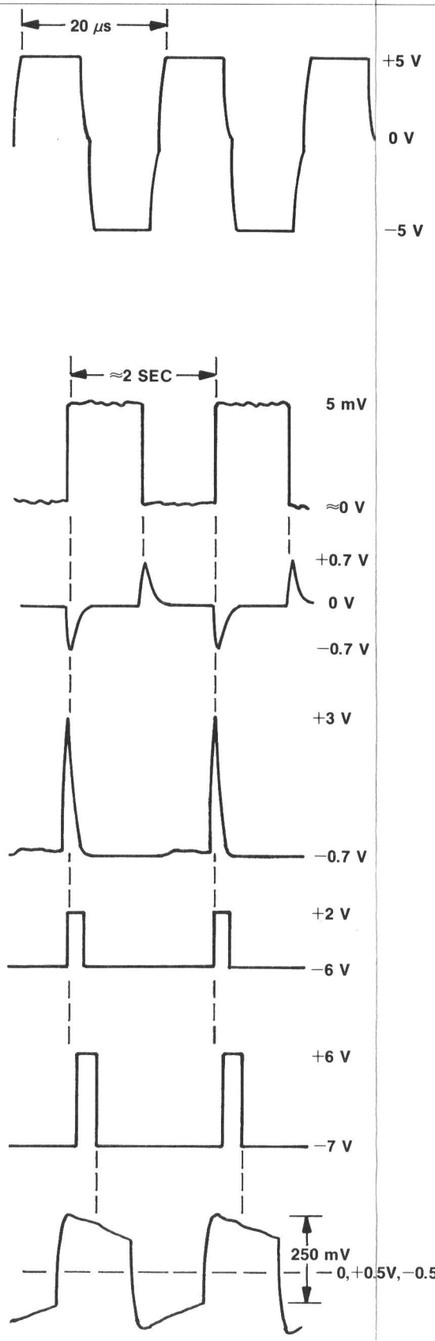
Partial A38 also shown on diagrams 1, 3, 4, 5, 6, 7, 8 and 9.

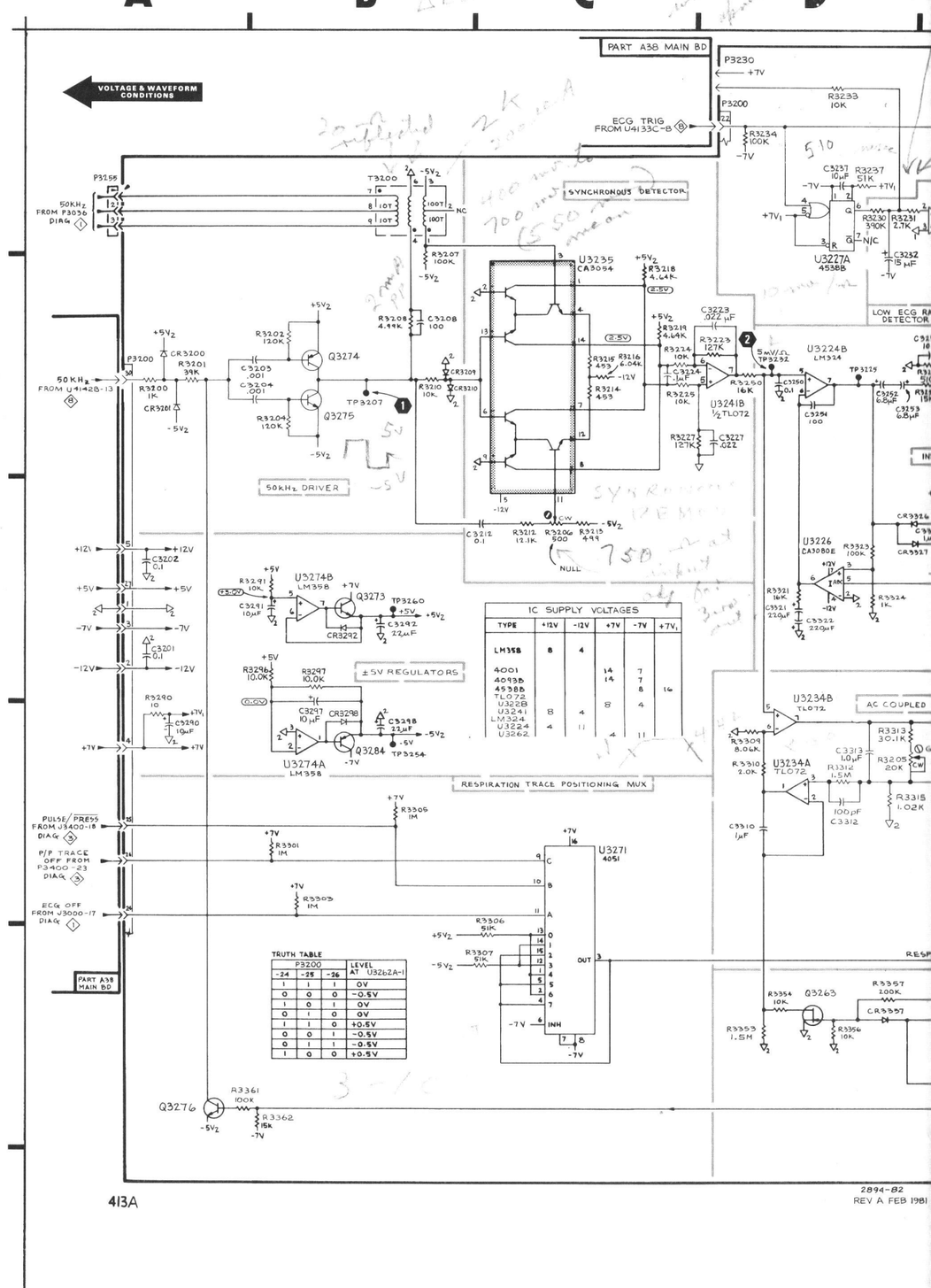
CHASSIS MOUNTED PARTS

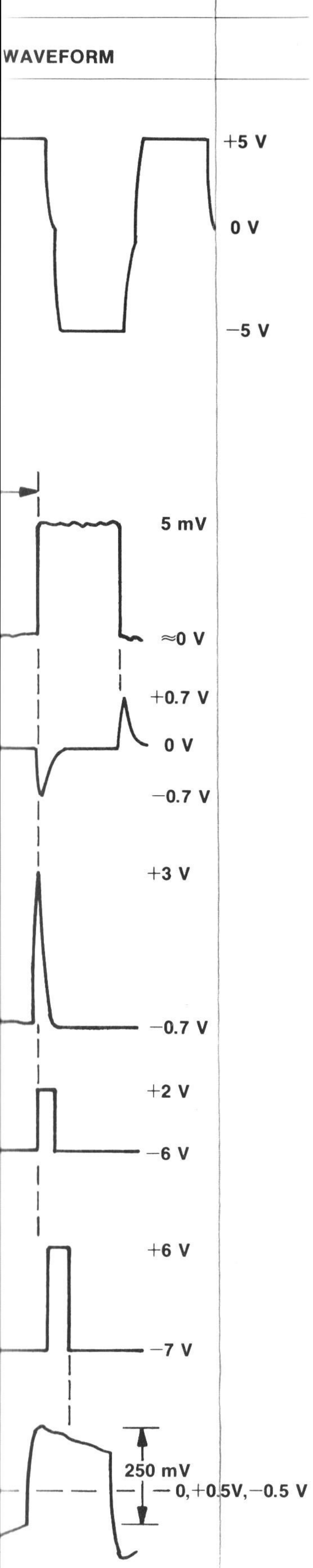
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS5322	H2	CHASSIS
R5320	H4	CHASSIS
S5320	H5	CHASSIS

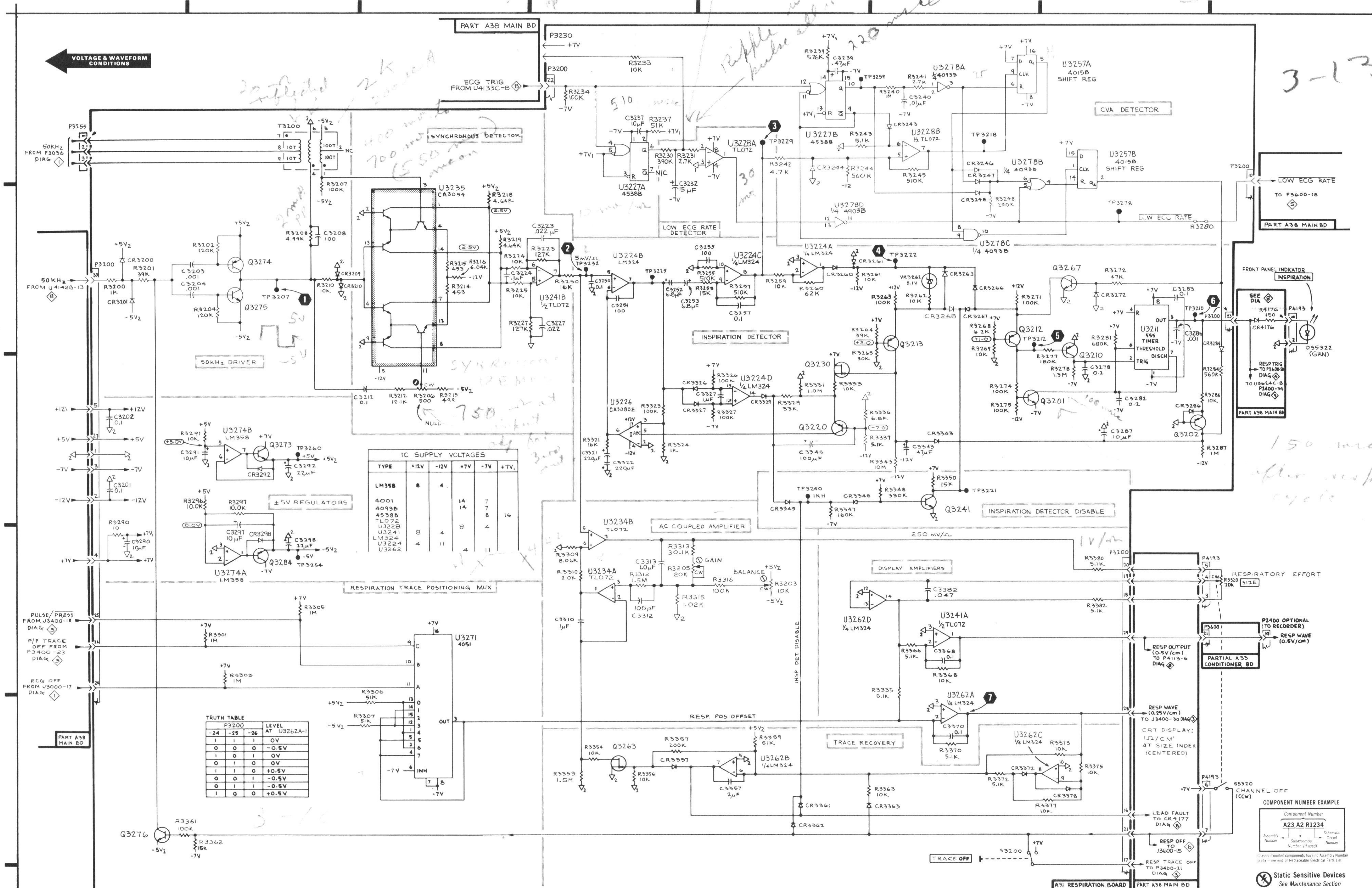
RESPIRATION ◇2

WAVEFORM NUMBER	DESCRIPTION	CONDITIONS	IDEALIZED WAVEFORM
1	TP3207 50 kHz	Front Panel RESP EFFORT SIZE POT MIDRANGE (NOT IN CCW DETENT)	
2	TP3232 SYNCHRONOUS DETECTOR OUTPUT	ABOVE-PLUS ECG/RESP LEAD TEST CONNECTED TO ECG/RESPIRATION PATIENT CABLE INPUT	
3	TP3229 INSPIRATION DETECTOR DIFFERENTIATOR	ABOVE	
4	TP3222 HALF WAVE RECTIFIER	ABOVE	
5	TP3212 INSPIRATION TIMER INPUT	ABOVE	
6	TP3210 INSPIRATION TIMER OUTPUT	ABOVE	
7	U3262A PIN 1 RESP WAVE (TO CRT DISPLAY)	ABOVE, RESP EFFORT SIZE POT EXACTLY AT 12 O'CLOCK INDEX MARK. DC LEVEL DEPENDS ON WHICH TRACES ARE DISPLAYED ON CRT. SEE TRUTH TABLE ON SCHEMATIC.	






WAVEFORM
+5 V
0 V
−5 V
5 mV
≈0 V
+0.7 V
0 V
−0.7 V
+3 V
−0.7 V
+2 V
−6 V
+6 V
−7 V
250 mV
0,+0.5V,−0.5 V


A
B
C
D
E
F
G
H
1
2
3
4
5
6
VOLTAGE & WAVEFORM CONDITIONS
PART A38 MAIN BD
ECG TRIG FROM U4133C-B
50KHz FROM P3036 DIAG
50 KHz FROM U4142B-13
SYNCHRONOUS DETECTOR
50kHz DRIVER
U3235 CA3054
LOW ECG RATE DETECTOR
U3227A 4538B
U3227B 4538B
U3228A TL072
U3228B ½ TL072
U3278A ¼ 4093B
U3278B ¼ 4093B
U3278C ¼ 4093B
U3278D ¼ 4093B
U3257A 4015B SHIFT REG
U3257B 4015B SHIFT REG
CVA DETECTOR
LOW ECG RATE TO P3600-18
C.W. ECG RATE
PART A38 MAIN BD
U3224B LM324
U3224C ¼ LM324
U3224A ¼ LM324
U3224D ¼ LM324
U3241B ½ TL072
INSPIRATION DETECTOR
INSPIRATION DETECTOR DISABLE
FRONT PANEL INDICATOR INSPIRATION
DS5322 (GRN)
U3211 555 TIMER
RESP TRIG TO P3400-16 DIAG
TO U3624C-B P2400-34 DIAG
PART A38 MAIN BD
U3274B LM358
U3274A LM358
±5V REGULATORS
IC SUPPLY VOLTAGES
RESPIRATION TRACE POSITIONING MUX
U3234B TL072
U3234A TL072
AC COUPLED AMPLIFIER
GAIN
BALANCE
250 mV/cm
DISPLAY AMPLIFIERS
U3262D ¼ LM324
U3241A ½ TL072
U3262A ¼ LM324
U3262B ¼ LM324
U3262C ¼ LM324
TRACE RECOVERY
RESP. POS OFFSET
INSP DET DISABLE
PULSE/PRESS FROM J3400-18 DIAG
P/P TRACE OFF FROM P3400-23 DIAG
ECG OFF FROM J3000-17 DIAG
U3271 4051
TRUTH TABLE
PART A38 MAIN BD
RESPIRATORY EFFORT
SIZE
P2400 OPTIONAL (TO RECORDER)
RESP WAVE (0.5V/cm)
RESP OUTPUT (0.5V/cm) TO P4113-6 DIAG
PARTIAL A33 CONDITIONER BD
RESP WAVE (0.25V/cm) TO J3400-30 DIAG
CRT DISPLAY: 1/2/CM AT SIZE INDEX (CENTERED)
S5320 CHANNEL OFF (CCW)
LEAD FAULT TO CR4177 DIAG
RESP OFF TO J3400-15 DIAG
RESP TRACE OFF TO P3400-21 DIAG
TRACE OFF
S3200
A31 RESPIRATION BOARD
PART A38 MAIN BD
COMPONENT NUMBER EXAMPLE
A23 A2 R1234
Static Sensitive Devices See Maintenance Section

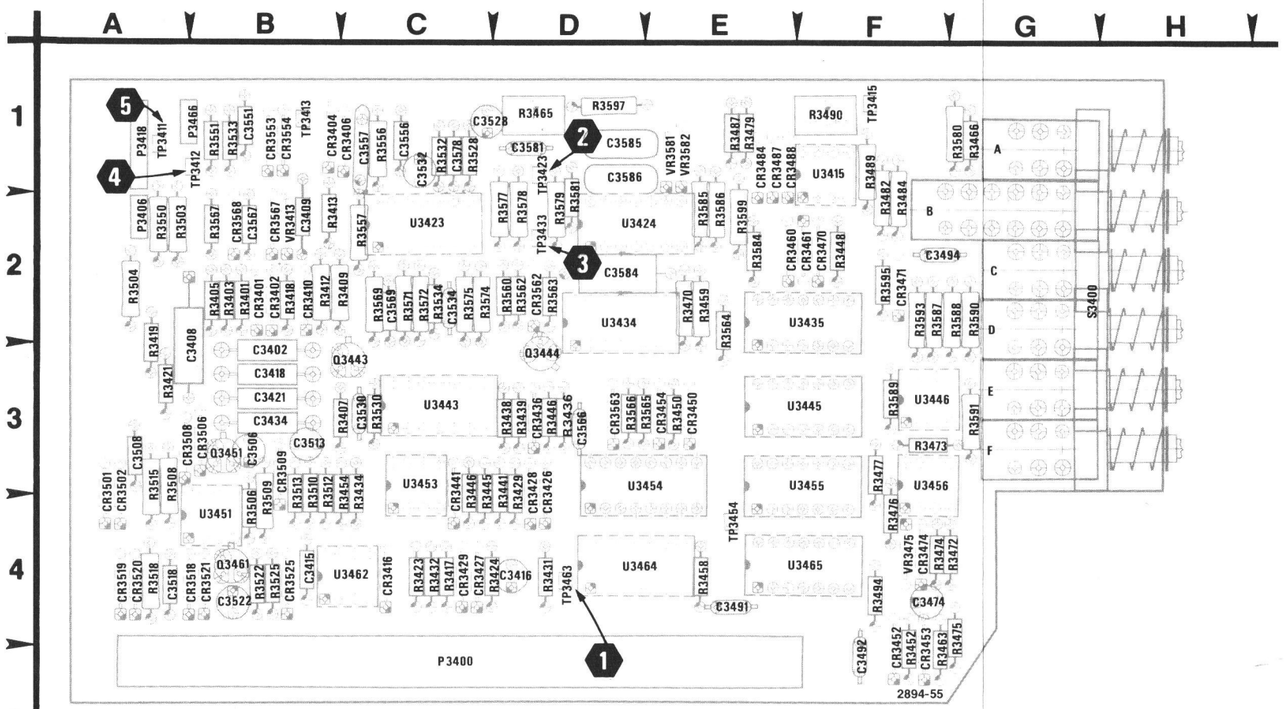
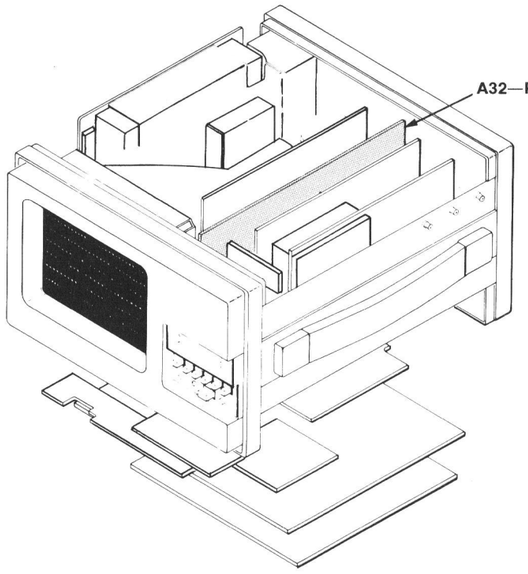


Fig. 8-7. A32-Pressure/Pulse board component locations.



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number
A23 A2 R1234
Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

PRESSURE/PULSE INPUT & TI

ASSEMBLY A32

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C3402	B1	B3	CR3436	E1	D3	R3401	A1	B2
C3408	B1	B2	CR3441	E2	C3	R3403	A1	B2
C3409	B1	B2	CR3450	A2	E3	R3405	A1	B2
C3415	C1	B4	CR3452	B2	F5	R3407	B1	C3
C3416	C1	D4	CR3453	B2	F5	R3409	B1	C2
C3418	C1	B3	CR3454	B2	E3	R3412	C1	B2
C3421	D1	B3	CR3460	B3	F2	R3413	C1	B2
C3434	E1	B3	CR3461	B3	F2	R3417	C1	C4
C3474	F2	F4	CR3470	E2	F2	R3418	C1	B2
C3491	F4	E4	CR3471	E2	F2	R3419	D1	A3
C3492	F4	F5	CR3474	F2	F4	R3421	D1	A3
C3494	F3	F2	CR3484	F3	E1	R3423	D1	C4
C3506	B3	B3	CR3487	F3	E1	R3424	D1	D4
C3508	B3	A3	CR3488	F3	E1	R3428	D1	D3
C3513	B3	B3	CR3501	B3	A3	R3429	D1	D4
C3518	B4	A4	CR3502	B3	A3	R3431	D1	D4
C3522	B4	B4	CR3506	B3	B3	R3432	D1	C4
C3528	B5	C1	CR3508	B3	B3	R3434	E1	C3
C3530	D1	C3	CR3509	B3	B3	R3436	E1	D3
C3532	B5	C1	CR3518	B4	B4	R3438	E1	D3
C3534	D1	C2	CR3519	B4	A4	R3439	E1	D3
C3551	B4	B1	CR3520	B4	A4	R3441	E2	D4
C3556	B4	C1	CR3521	B4	B4	R3445	E1	C3
C3557	B4	C1	CR3525	B4	B4	R3446	E2	C3
C3566	C4	D3	CR3553	B4	B1	R3448	F1	F2
C3567	B5	B2	CR3554	B4	B1	R3450	B2	E3
C3569	B5	C2	CR3562	C4	D2	R3452	B2	F5
C3578	C5	C1	CR3563	C4	D3	R3454	B2	C3
C3581	D5	D1	CR3567	B5	B2	R3458	C3	E4
C3584	D5	D2	CR3568	B5	B2	R3459	A3	E2
C3585	E5	D1				R3463	D2	G4
C3586	E5	D1	P3400	A2	D5	R3465	E2	D1
			P3400	D1	D5	R3466	E2	G1
CR3401	B1	B2	P3400	G1	C5	R3470	E2	E2
CR3402	B1	B2	P3406	A1	A2	R3472	F2	G4
CR3404	B1	B1	P3418	A4	A1	R3473	F2	F3
CR3406	B1	C1	P3466	C5	B1	R3474	F2	F4
CR3410	B1	B2				R3475	F2	G4
CR3416	C1	C4	Q3443	B1	C3	R3476	F2	F4
CR3426	D1	D4	Q3444	C4	D3	R3477	F2	F3
CR3427	D1	C4	Q3451	B3	B3	R3479	F2	E1
CR3428	D1	D4	Q3461	B4	B4	R3482	F2	F2
CR3429	D1	C4				R3484	F3	F2

Partial A32 also shown on diagrams 6 and 8.

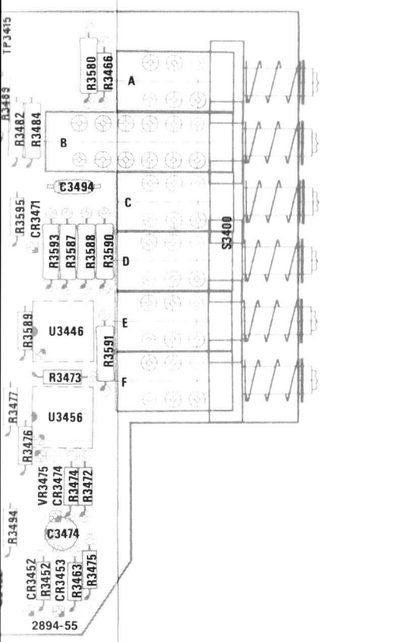
ASSEMBLY A33

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J3600	G1	A4	P2400	H2	C1			

Partial A33 also shown on diagrams 1, 2, 4, 5, 6 and 9.

CHASSIS MOUNTED PARTS

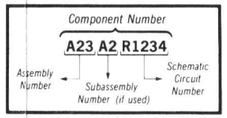
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C5341	A1	CHASSIS	C5343	A1	CHASSIS	J5340	A1	CHASSIS
C5342	A1	CHASSIS				J5345	A4	CHASSIS



LSE BD.

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

PRESSURE/PULSE INPUT & TRACE CHOPPING DIAGRAM 3

ASSEMBLY A32

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C3402	B1	B3	CR3436	E1	D3	R3401	A1	B2	R3487	F3	E1	R3585	E5	E2	U3435B	D4	F2
C3408	B1	B2	CR3441	E2	C3	R3403	A1	B2	R3489	F2	F1	R3586	E5	E2	U3435C	D4	F2
C3409	B1	B2	CR3450	A2	E3	R3405	A1	B2	R3490	E2	F1	R3587	F5	F2	U3435D	D4	F2
C3415	C1	B4	CR3452	B2	F5	R3407	B1	C3	R3494	G3	F4	R3588	F5	G2	U3443A	D1	C3
C3416	C1	D4	CR3453	B2	F5	R3409	B1	C2	R3503	A3	A2	R3589	F5	F3	U3443B	E2	C3
C3418	C1	B3	CR3454	B2	E3	R3412	C1	B2	R3504	A3	A2	R3590	F4	G2	U3443C	E1	C3
C3421	D1	B3	CR3460	B3	F2	R3413	C1	B2	R3506	B3	B4	R3591	F5	G3	U3443D	C1	C3
C3434	E1	B3	CR3461	B3	F2	R3417	C1	C4	R3508	B3	A3	R3593	F5	F2	U3445A	D3	F3
C3474	F2	F4	CR3470	E2	F2	R3418	C1	B2	R3509	B3	B4	R3595	F5	F2	U3445B	E3	F3
C3491	F4	E4	CR3471	E2	F2	R3419	D1	A3	R3510	C3	B4	R3597	F5	D1	U3445C	C4	F3
C3492	F4	F5	CR3474	F2	F4	R3421	D1	A3	R3512	C3	B4	R3599	F5	E2	U3445D	C3	F3
C3494	F3	F2	CR3484	F3	E1	R3423	D1	C4	R3513	B3	B3				U3446A	E5	F3
C3506	B3	B3	CR3487	F3	E1	R3424	D1	D4	R3515	B3	A3	S3400A	D2	G2	U3446B	F5	F3
C3508	B3	A3	CR3488	F3	E1	R3428	D1	D3	R3518	B4	A4	S3400B	F1	G2	U3451A	B4	B4
C3513	B3	B3	CR3501	B3	A3	R3429	D1	D4	R3522	B4	B4	S3400C	F4	G2	U3451B	B3	B4
C3518	B4	A4	CR3502	B3	A3	R3431	D1	D4	R3525	C4	B4	S3400D	F4	G2	U3453A	E1	C3
C3522	B4	B4	CR3506	B3	B3	R3432	D1	C4	R3528	B4	C1	S3400E	F4	G2	U3453B	B1	C3
C3528	B5	C1	CR3508	B3	B3	R3434	E1	C3	R3530	D1	C3	S3400F	A5	G2	U3454	D3	E3
C3530	D1	C3	CR3509	B3	B3	R3436	E1	D3	R3532	B5	C1				U3455A	D4	F3
C3532	B5	C1	CR3518	B4	B4	R3438	E1	D3	R3534	D1	C2	TP3411	A4	A1	U3455B	F2	F3
C3534	D1	C2	CR3519	B4	A4	R3439	E1	D3	R3550	A5	A2	TP3412	A3	B1	U3455C	C4	F3
C3551	B4	B1	CR3520	B4	A4	R3441	E2	D4	R3551	B4	B1	TP3413	B1	B1	U3455D	C3	F3
C3556	B4	C1	CR3521	B4	B4	R3445	E1	C3	R3553	B4	B1	TP3415	G2	F1	U3455E	D3	F3
C3557	B4	C1	CR3525	B4	B4	R3446	E2	C3	R3556	B4	C1	TP3423	D4	D1	U3455F	E3	F3
C3566	C4	D3	CR3553	B4	B1	R3448	F1	F2	R3557	B5	C2	TP3433	D4	D2	U3456A	F2	F3
C3567	B5	B2	CR3554	B4	B1	R3450	B2	E3	R3560	B4	D2	TP3454	G2	E4	U3456B	F2	F3
C3569	B5	C2	CR3562	C4	D2	R3452	B2	F5	R3562	B4	D2	TP3463	D3	D4	U3462	C1	C4
C3578	C5	C1	CR3563	C4	D3	R3454	B2	C3	R3563	C4	D2				U3464A	C3	E4
C3581	D5	D1	CR3567	B5	B2	R3458	C3	E4	R3564	C4	E2	U3415A	F2	F1	U3464B	D3	E4
C3584	D5	D2	CR3568	B5	B2	R3459	A3	E2	R3565	C4	E3	U3415B	F2	F1	U3465A	D2	F4
C3585	E5	D1				R3463	D2	G4	R3566	C4	D3	U3423A	B5	C2	U3465A	D3	F4
C3586	E5	D1	P3400	A2	D5	R3465	E2	D1	R3567	B5	B2	U3423B	B5	C2	U3465B	E2	F4
			P3400	D1	D5	R3466	E2	G1	R3569	B5	C2	U3423C	C5	C2	U3465C	E3	F4
CR3401	B1	B2	P3400	G1	C5	R3470	E2	E2	R3571	B5	C2	U3423D	B4	C2	U3465D	D2	F4
CR3402	B1	B2	P3406	A1	A2	R3472	F2	G4	R3572	C5	C2	U3424	D5	D2			
CR3404	B1	B1	P3418	A4	A1	R3473	F2	F3	R3574	B5	C2	U3424B	E5	D2	VR3413	C1	B2
CR3406	B1	C1	P3466	C5	B1	R3474	F2	F4	R3575	C5	C2	U3424C	F5	D2	VR3475	F2	F4
CR3410	B1	B2				R3475	F2	G4	R3577	C5	D2	U3424D	E5	D2	VR3581	D5	E1
CR3416	C1	C4	Q3443	B1	C3	R3476	F2	F4	R3578	C5	D2	U3434A	D4	D2	VR3582	D5	E1
CR3426	D1	D4	Q3444	C4	D3	R3477	F2	F3	R3579	C5	D2	U3434B	E3	D2			
CR3427	D1	C4	Q3451	B3	B3	R3479	F2	E1	R3580	C5	G1	U3434C	E2	D2			
CR3428	D1	D4	Q3461	B4	B4	R3482	F2	F2	R3581	D5	D2	U3434D	D5	D2			
CR3429	D1	C4				R3484	F3	F2	R3584	D5	E2	U3435A	D3	F2			

Partial A32 also shown on diagrams 6 and 8.

ASSEMBLY A33

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J3600	G1	A4	P2400	H2	C1			

Partial A33 also shown on diagrams 1, 2, 4, 5, 6 and 9.

ASSEMBLY A38

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P4174	D1	D7	P4176	A2	D7	P4194	A3	D7

Partial A38 also shown on diagrams 1, 2, 4, 5, 6, 7, 8 and 9.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C5341	A1	CHASSIS	C5343	A1	CHASSIS	J5340	A1	CHASSIS	R5344A	A3	CHASSIS	R5350	D1	CHASSIS			
C5342	A1	CHASSIS				J5345	A4	CHASSIS	R5344B	A3	CHASSIS						

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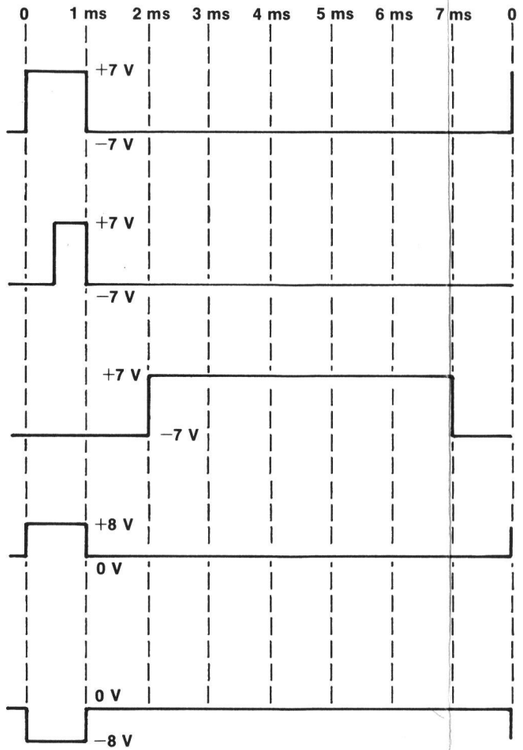
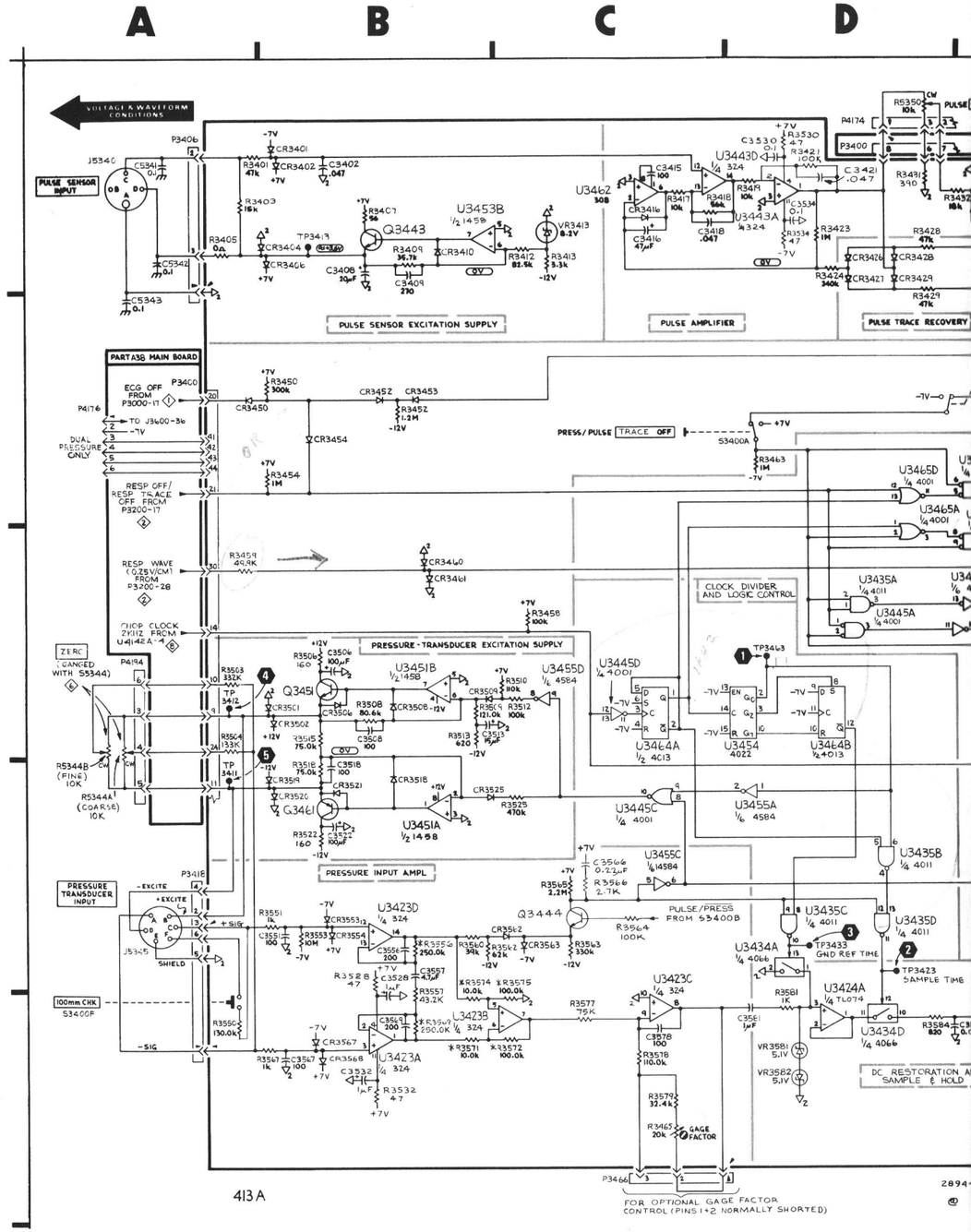
PRESSURE/PULSE ◇3

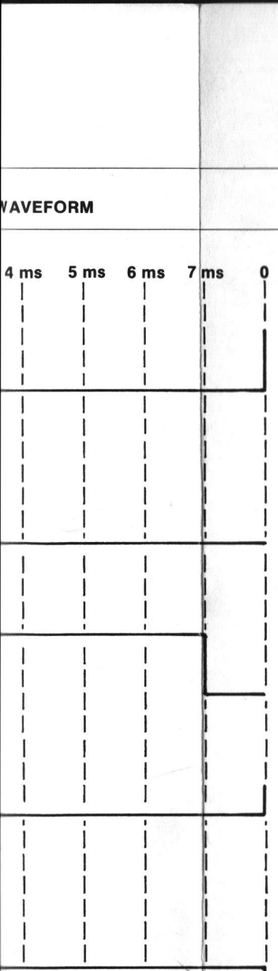
WAVEFORM NUMBER	DESCRIPTION	CONDITIONS	IDEALIZED WAVEFORM
1	TP3463 TIME ZERO (TEST OSCILLOSCOPE EXT TRIG)	PRESSURE TRANSDUCER CONNECTED. 125 mm RANGE SELECTED.	
2	TP3423 SAMPLE TIME	ABOVE, TEST OSCILLOSCOPE EXTERNALLY TRIGGERED ON WAVEFORM NUMBER (1)	
3	TP3433 GND REF TIME	ABOVE	
4	TP3412 + EXCITE	ABOVE	
5	TP3411 – EXCITE	ABOVE	

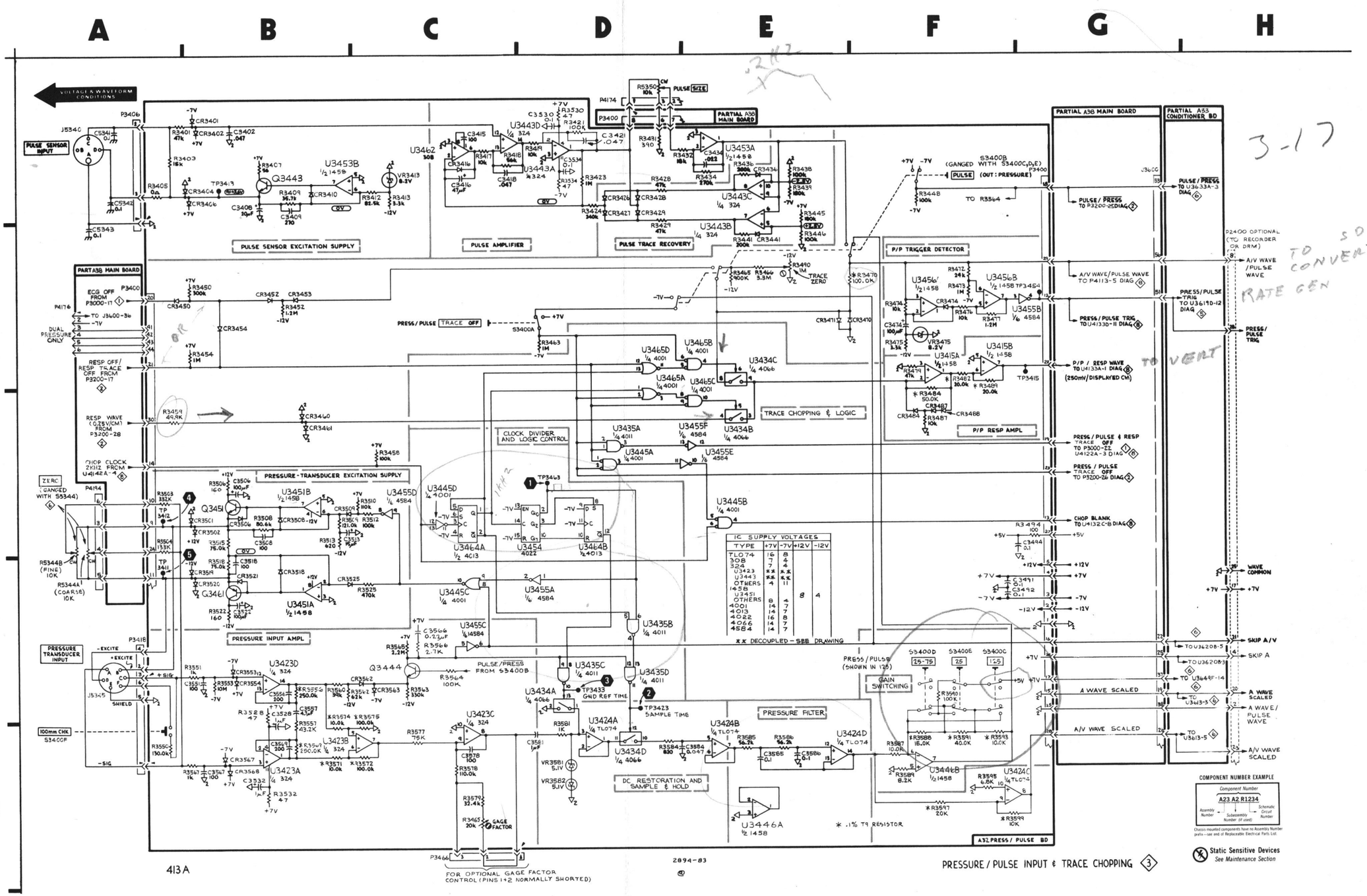




WAVEFORM

4 ms 5 ms 6 ms 7 ms 0





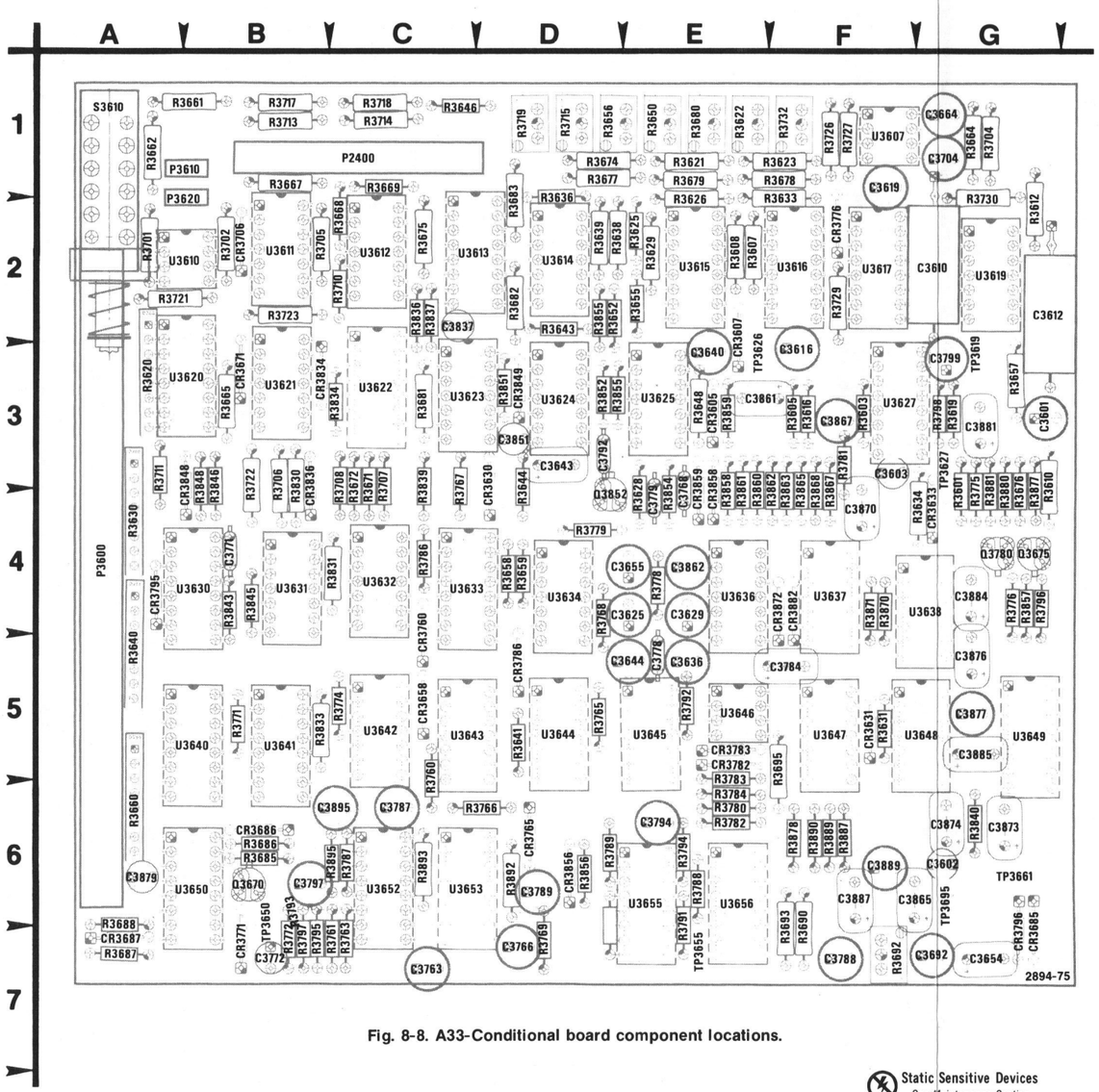
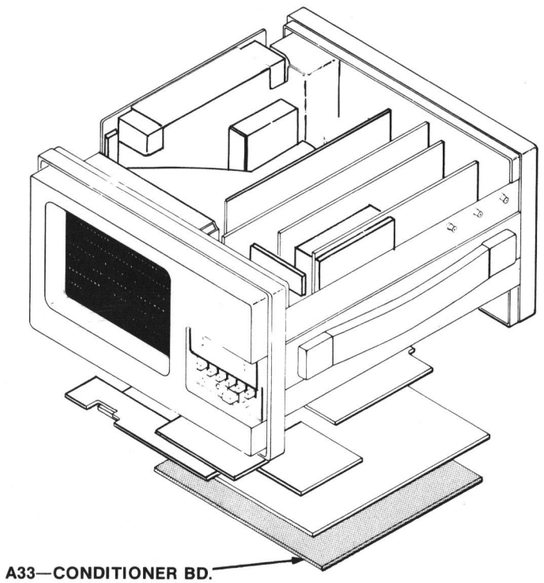


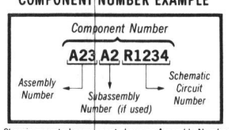
Fig. 8-8. A33-Conditional board component locations.



A33—CONDITIONER BD.

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

TEMPERATURE AN

ASSEMBLY A33

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATIO
C3601	B1	G3	R3612	D1
C3602	B1	G6	R3616	F1
C3603	B2	F3	R3619	D2
C3610	C2	G2	R3620	G3
C3612	D1	G2	R3621	D2
C3616	F1	F3	R3622	D2
C3619	D2	F1	R3623	D2
C3625	D2	E4	R3625	D2
C3629	E2	E4	R3626	D2
C3636	F2	E5	R3628	E2
C3640	F2	E3	R3629	E2
C3643	F2	D3	R3631	E2
C3644	G2	E5	R3633	E2
C3654	E2	G7	R3634	E2
C3655	E2	E4	R3636	E2
C3664	B3	G1	R3638	F2
C3692	C4	G7	R3639	F2
C3704	B5	G1	R3640	B2
			R3640	C1
CR3605	C2	E3	R3641	F2
CR3607	C2	E3	R3643	F2
CR3631	E2	F5	R3644	F2
CR3633	E2	G4	R3646	G2
CR3658	F3	C5	R3648	G2
CR3671	B3	B3	R3650	G2
CR3685	G3	G6	R3652	E2
CR3686	G3	B6	R3654	E2
CR3687	G3	A7	R3655	F2
CR3706	B5	B2	R3656	F2
			R3657	F2
J3600	B6	A4	R3658	F3
J3600	G2	A4	R3659	F3
J3600	G4	A4	R3661	B3
			R3662	B3
P2400	G1	C1	R3664	B3
P2400	G3	C1	R3665	B3
P3610	B2	B1	R3667	C3
P3620	A4	B2	R3668	C3
			R3669	C3
R3601	B1	G4	R3671	B4
R3603	B2	F3	R3672	B4
R3605	C2	F3	R3674	C3
R3607	C2	E2	R3675	C3
R3608	C2	E2	R3677	C3
R3610	C2	G4	R3678	D3

Partial A33 also shown on diagrams 1, 2, 3, 5, 6 and 9.

ASSEMBLY A37

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION
DS4070	H3	C1	P2356	H3
DS4080	H3	C1		

Partial A37 also shown on diagrams 6 and 7.

ASSEMBLY A38

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION
P4114	H2	B1	P4118	H3

Partial A38 also shown on diagrams 1, 2, 3, 5, 6, 7, 8 and 9.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION
J5361	A2	CHASSIS	J5362	A4

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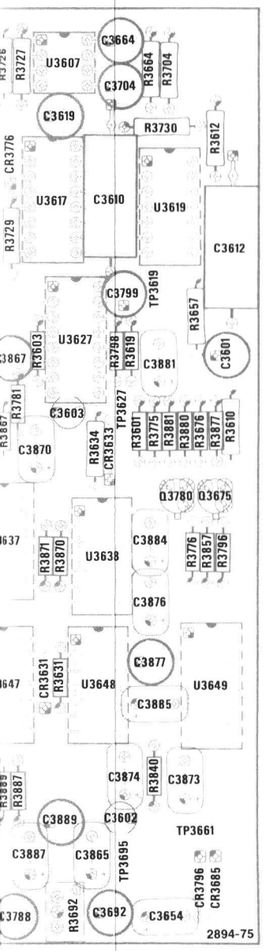
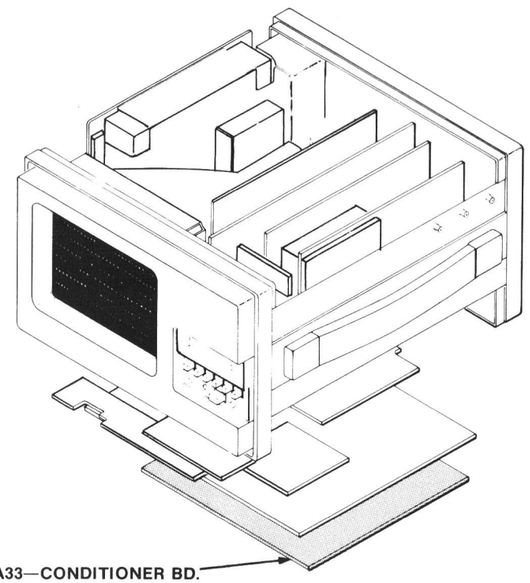
F G

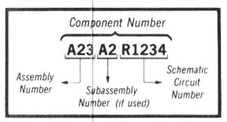




A33—CONDITIONER BD.

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

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TEMPERATURE AND RATE CONVERTERS DIAGRAM 4

ASSEMBLY A33

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C3601	B1	G3	R3612	D1	G2	R3679	D3	E1	U3610A	B5	B2
C3602	B1	G6	R3616	F1	F3	R3680	D3	E1	U3610B	B3	B2
C3603	B2	F3	R3619	D2	G3	R3681	D3	C3	U3611	C3	B2
C3610	C2	G2	R3620	G3	A3	R3682	D3	D2	U3611B	C5	B2
C3612	D1	G2	R3621	D2	E1	R3683	D3	D2	U3611C	E5	B2
C3616	F1	F3	R3622	D2	E1	R3685	G3	B6	U3611D	D3	B2
C3619	D2	F1	R3623	D2	F1	R3686	G3	B6	U3612A	D4	C2
C3625	D2	E4	R3625	D2	E2	R3687	G3	A7	U3612B	C3	C2
C3629	E2	E4	R3626	D2	E2	R3688	G3	A7	U3612C	C5	C2
C3636	F2	E5	R3628	E2	E4	R3690	B4	F7	U3612D	C6	C2
C3640	F2	E3	R3629	E2	E2	R3692	B4	F7	U3613A	D3	C2
C3643	F2	D3	R3631	E2	F5	R3693	B4	F7	U3613C	D3	C2
C3644	G2	E5	R3633	E2	F2	R3695	C4	F5	U3614A	F2	D2
C3654	E2	G7	R3634	E2	G4	R3701	B5	A2	U3614B	G2	D2
C3655	E2	E4	R3636	E2	D2	R3702	B5	B2	U3614C	F2	D2
C3664	B3	G1	R3638	F2	D2	R3704	B5	G1	U3614D	E2	D2
C3692	C4	G7	R3639	F2	D2	R3705	C5	B2	U3615A	C2	E2
C3704	B5	G1	R3640	B2	A5	R3706	B5	B3	U3615B	E2	E2
			R3640	C1	A5	R3707	B6	C3	U3616A	F1	F2
CR3605	C2	E3	R3641	F2	D5	R3708	B6	C3	U3616B	D2	F2
CR3607	C2	E3	R3643	F2	D2	R3710	C5	C2	U3617A	C2	F2
CR3631	E2	F5	R3644	F2	D3	R3711	C5	A3	U3617B	D1	F2
CR3633	E2	G4	R3646	G2	C1	R3713	C4	B1	U3619A	D2	G2
CR3658	F3	C5	R3648	G2	E3	R3714	D4	C1	U3619B	E1	G2
CR3671	B3	B3	R3650	G2	E1	R3715	D4	D1	U3619C	C1	G2
CR3685	G3	G6	R3652	E2	D2	R3717	D5	B1	U3620A	D5	B3
CR3686	G3	B6	R3654	E2	D3	R3718	D5	C1	U3620C	D5	B3
CR3687	G3	A7	R3655	F2	E2	R3719	D5	D1	U3621B	B6	B3
CR3706	B5	B2	R3656	F2	D1	R3721	D5	B2	U3621C	B4	B3
			R3657	F2	G3	R3722	D5	B3	U3622	F5	C3
J3600	B6	A4	R3658	F3	D4	R3723	D5	B2	U3623B	D4	C3
J3600	G2	A4	R3659	F3	D4	R3726	E4	F1	U3623C	D6	C3
J3600	G4	A4	R3661	B3	B1	R3727	E4	F1	U3627A	B2	F3
			R3662	B3	A1	R3729	E4	F2	U3630A	G3	B4
P2400	G1	C1	R3664	B3	G1	R3730	E4	G2	U3630B	G3	B4
P2400	G3	C1	R3665	B3	B3	R3732	E4	F1	U3633F	G4	C4
P3610	B2	B1	R3667	C3	B1				U3645C	D6	E5
P3620	A4	B2	R3668	C3	C2	S3610	A3	A1	U3645D	D4	E5
			R3669	C3	C1				U3647D	C4	F5
R3601	B1	G4	R3671	B4	C3	TP3619	E1	G3	U3649A	E3	G5
R3603	B2	F3	R3672	B4	C3	TP3626	C2	E3	U3649C	F5	G5
R3605	C2	F3	R3674	C3	D1	TP3661	B1	G6	U3649D	G3	G5
R3607	C2	E2	R3675	C3	C2	TP3695	C4	G6	U3649E	E3	G5
R3608	C2	E2	R3677	C3	D1						
R3610	C2	G4	R3678	D3	F1	U3607	E4	F1			

Partial A33 also shown on diagrams 1, 2, 3, 5, 6 and 9.

ASSEMBLY A37

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS4070	H3	C1	P2356	H3	A2						
DS4080	H3	C1									

Partial A37 also shown on diagrams 6 and 7.

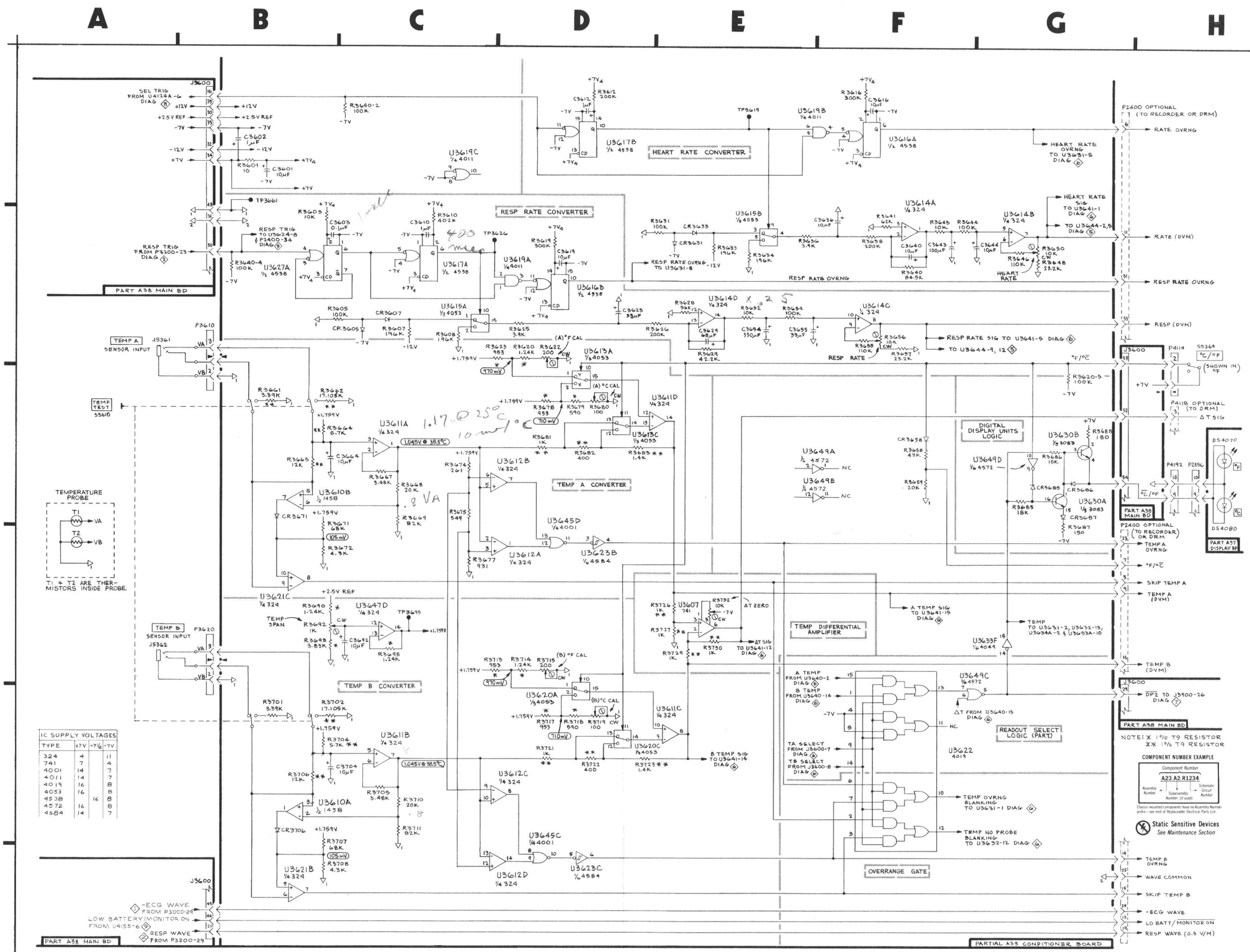
ASSEMBLY A38

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P4114	H2	B1	P4118	H3	G1	P4192	H3	B7			

Partial A38 also shown on diagrams 1, 2, 3, 5, 6, 7, 8 and 9.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J5361	A2	CHASSIS	J5362	A4	CHASSIS	S5364	H2	CHASSIS			


HEART RATE CONVERTER
RESP RATE CONVERTER
TEMP A CONVERTER
TEMP B CONVERTER
TEMP DIFFERENTIAL AMPLIFIER
DIGITAL DISPLAY UNITS LOGIC
READOUT SELECT LOGIC (PART)
OVERRANGE GATE
PART A38 MAIN BD
PARTIAL A33 CONDITIONER BOARD
SEL TRIG FROM U4128A-6 DIAG 8
RESP TRIG FROM P3200-23 DIAG 2
RESP TRIG TO U3624-8 & P2400-34 DIAG 6
TEMP A SENSOR INPUT J5361
TEMP B SENSOR INPUT J5362
TEMP TEST 55610
TEMPERATURE PROBE
T1 & T2 ARE THERMISTORS INSIDE PROBE.
P2400 OPTIONAL (TO RECORDER OR DRM)
RATE OVRNG
HEART RATE OVRNG TO U3651-5 DIAG 6
HEART RATE SIG TO U3641-1 DIAG 6
TO U3644-2,5 DIAG 5
RATE (DVM)
RESP RATE OVRNG
RESP (DVM)
RESP RATE SIG TO U3641-5 DIAG 6
TO U3644-9, 12 5
RESP RATE OVRNG TO U3631-8
HEART RATE
RESP RATE
(A) °F CAL
(A) °C CAL
(B) °F CAL
(B) °C CAL
°F/°C
P4114
55364
(SHOWN IN) °F
P4118 OPTIONAL (TO DRM)
ΔT SIG
P4192
P2356
DS4070
DS4080
PART A37 DISPLAY BD
TEMP A OVRNG
SKIP TEMP A
TEMP A (DVM)
TEMP TO U3631-2, U3632-13, U3634A-2 & U3653A-10
TEMP B (DVM)
DP2 TO J3900-26 DIAG 7
TEMP B OVRNG
WAVE COMMON
SKIP TEMP B
-ECG WAVE
LO BATT/MONITOR ON
RESP WAVE (0.5 V/M)
A TEMP SIG TO U3641-15 DIAG 6
B TEMP SIG TO U3641-14 DIAG 6
ΔT SIG TO U3641-12 DIAG 6
ΔT FROM U3640-15 DIAG 6
A TEMP FROM U3640-7 DIAG 6
B TEMP FROM U3640-14 DIAG 6
TA SELECT FROM U3600-7 DIAG 6
TB SELECT FROM U3600-8 DIAG 6
TEMP OVRNG BLANKING TO U3631-1 DIAG 6
TEMP NO PROBE BLANKING TO U3632-12 DIAG 6
-ECG WAVE FROM P3000-29
LOW BATTERY/MONITOR ON FROM U4155-6 2
RESP WAVE FROM P3200-29
NOTE: X 1% T9 RESISTOR
XX 1% T9 RESISTOR
COMPONENT NUMBER EXAMPLE
A23 A2 R1234
Assembly Number
Subassembly Number (if used)
Schematic Circuit Number
Chassis mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.
Static Sensitive Devices
See Maintenance Section
IC SUPPLY VOLTAGES
TYPE | +7V | -7½ | -7V
324 | 4 | | 11
741 | 7 | | 4
4001 | 14 | | 7
4011 | 14 | | 7
4019 | 16 | | 8
4053 | 16 | | 8
4538 | | 16 | 8
4572 | 16 | | 8
4584 | 14 | | 7

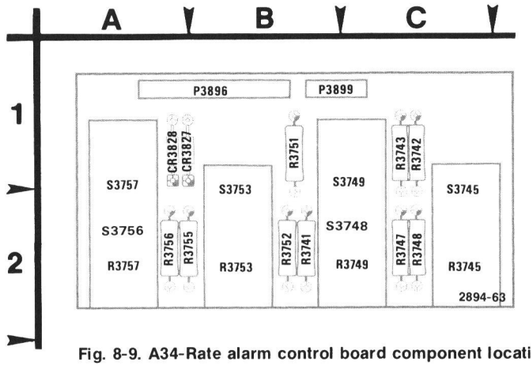
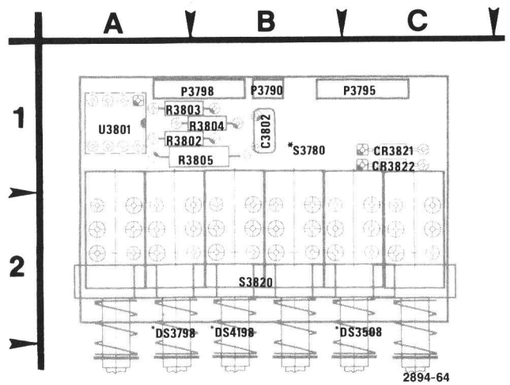


Fig. 8-9. A34-Rate alarm control board component locations.



* Mounted on back of board.

Fig. 8-10. A35-Readout switch board component locations.

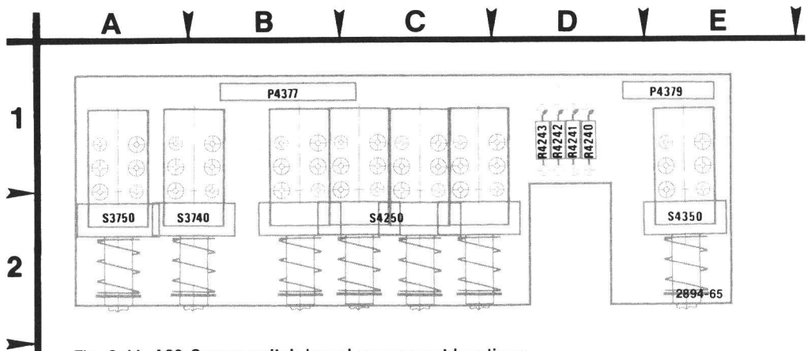
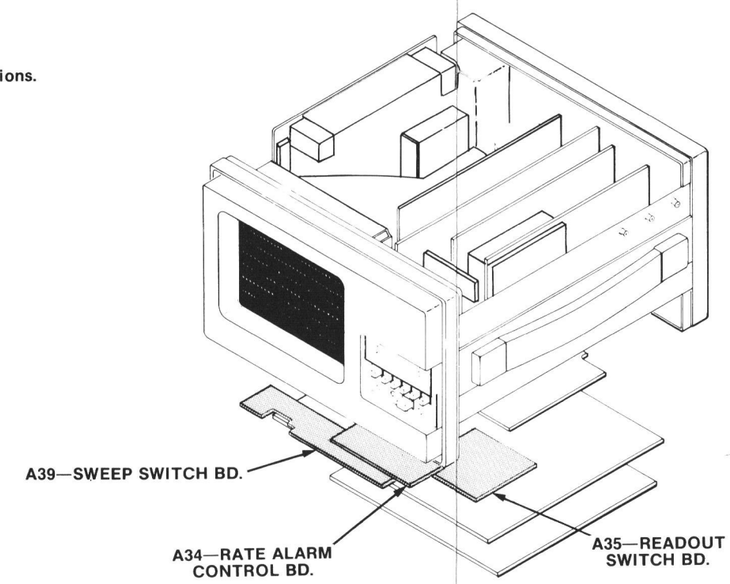
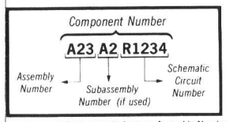


Fig. 8-11. A39-Sweep switch board component locations.



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

ALARM DIAGRAM 5

ASSEMBLY A33

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C3601	C4	G3	P2400	G1	C1	R3778	E3	E4
C3763	D1	C7	P2400	G5	C1	R3779	E3	D4
C3766	D2	D7	P3600	B1	A4	R3780	C3	E6
C3768	E2	E4				R3781	C3	F3
C3771	E2	B4	Q3670	E2	B6	R3782	C3	E6
C3772	F2	B7	Q3675	F2	G4	R3783	D3	E6
C3778	E3	E5	Q3780	F2	G4	R3784	D3	E6
C3779	E3	E4				R3786	F3	C4
C3784	D3	F5	R3601	C4	G4	R3787	C4	C6
C3787	C4	C6	R3620	C3	A3	R3788	C4	E6
C3788	C4	F7	R3620	C4	A3	R3789	E4	D6
C3789	E4	D6	R3630	B3	A4	R3791	E4	E7
C3792	E4	D3	R3630	C6	A4	R3792	E4	E5
C3794	C5	E6	R3630	D4	A4	R3793	E4	D6
C3797	D5	B6	R3630	F1	A4	R3794	C5	E6
C3799	D6	G3	R3660	D5	A6	R3795	D5	B7
			R3760	D1	C5	R3796	E5	G4
CR3630	C5	D3	R3761	D1	C7	R3797	D5	B7
CR3760	D1	C4	R3763	D1	C7	R3798	E5	G3
CR3765	D2	D6	R3765	D2	D5			
CR3771	E2	B7	R3766	D2	D6	TP3627	D6	G3
CR3776	G2	F2	R3767	D2	C3	TP3652	D5	B6
CR3782	C3	E5	R3768	E2	D4	TP3655	C5	E7
CR3783	C3	E5	R3769	E1	D7			
CR3786	G3	D5	R3771	E2	B5	U3619D	C3	G2
CR3795	D5	A4	R3772	F2	B7	U3623D	D2	C3
CR3796	D5	G6	R3774	E2	C5	U3623E	D1	C3
			R3775	F2	G4	U3623F	F2	C3
J3600	G1	A4	R3776	F2	G4	U3624A	F2	D3

Partial A33 also shown on diagrams 1, 2, 3, 4, 6 and 9.

ASSEMBLY A34

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P3896	B1	B1	R3743	A1	C1	R3751	A2	B1
P3899	B1	C1	R3745	A1	C2	R3752	A2	B2
			R3747	A1	C2	R3753	A2	B2
R3741	A1	B2	R3748	A2	C2	R3755	A2	B2
R3742	A1	C1	R3749	A2	C2	R3756	A2	A2

Partial A34 also shown on diagram 6.

ASSEMBLY A35

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C3802	G4	B1	P3790	H3	B1	R3803	H4	B1
			P3798	B4	B1	R3804	H4	B1
DS3508	H4	C3				R3805	H4	B1
			R3802	G4	B1			

Partial A35 also shown on diagrams 6, 8 and 9.

ASSEMBLY A38

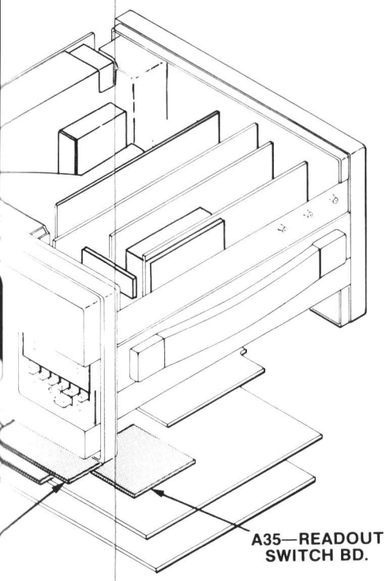
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P4113	H1	D1	P4190	H3	A7	P4198	B4	G7
P4177	B4	F7	P4196	B1	F7	P4199	B1	G7

Partial A38 also shown on diagrams 1, 2, 3, 4, 6, 7, 8 and 9.

ASSEMBLY A39

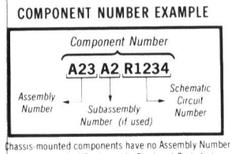
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P4379	B4	E1	S3740	A4	B2	S3750	A4	A2

Partial A39 also shown on diagrams 8 and 9.



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

ALARM DIAGRAM 5

ASSEMBLY A33

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C3601	C4	G3	P2400	G1	C1	R3778	E3	E4	U3624C	C5	D3
C3763	D1	C7	P2400	G5	C1	R3779	E3	D4	U3624D	F2	D3
C3766	D2	D7	P3600	B1	A4	R3780	C3	E6	U3625	E2	E3
C3768	E2	E4				R3781	C3	F3	U3627B	D6	F3
C3771	E2	B4	Q3670	E2	B6	R3782	C3	E6	U3630C	G3	B4
C3772	F2	B7	Q3675	F2	G4	R3783	D3	E6	U3633D	E3	C4
C3778	E3	E5	Q3780	F2	G4	R3784	D3	E6	U3633E	F3	C4
C3779	E3	E4				R3786	F3	C4	U3634D	F3	D4
C3784	D3	F5	R3601	C4	G4	R3787	C4	C6	U3642C	F3	C5
C3787	C4	C6	R3620	C3	A3	R3788	C4	E6	U3643A	C2	C5
C3788	C4	F7	R3620	C4	A3	R3789	E4	D6	U3643B	C1	C5
C3789	E4	D6	R3630	B3	A4	R3791	E4	E7	U3643C	C2	C5
C3792	E4	D3	R3630	C6	A4	R3792	E4	E5	U3643D	C2	C5
C3794	C5	E6	R3630	D4	A4	R3793	E4	D6	U3644A	C2	D5
C3797	D5	B6	R3630	F1	A4	R3794	C5	E6	U3644B	C1	D5
C3799	D6	G3	R3660	D5	A6	R3795	D5	B7	U3644C	C2	D5
			R3760	D1	C5	R3796	E5	G4	U3644D	C2	D5
CR3630	C5	D3	R3761	D1	C7	R3797	D5	B7	U3645A	D2	E5
CR3760	D1	C4	R3763	D1	C7	R3798	E5	G3	U3645B	D1	E5
CR3765	D2	D6	R3765	D2	D5				U3646A	C3	E5
CR3771	E2	B7	R3766	D2	D6	TP3627	D6	G3	U3646B	D3	E5
CR3776	G2	F2	R3767	D2	C3	TP3652	D5	B6	U3652B	D5	C6
CR3782	C3	E5	R3768	E2	D4	TP3655	C5	E7	U3653B	D6	C6
CR3783	C3	E5	R3769	E1	D7				U3655A	E4	E6
CR3786	G3	D5	R3771	E2	B5	U3619D	C3	G2	U3655B	C5	E6
CR3795	D5	A4	R3772	F2	B7	U3623D	D2	C3	U3656A	D6	E6
CR3796	D5	G6	R3774	E2	C5	U3623E	D1	C3			
			R3775	F2	G4	U3623F	F2	C3			
J3600	G1	A4	R3776	F2	G4	U3624A	F2	D3			

Partial A33 also shown on diagrams 1, 2, 3, 4, 6 and 9.

ASSEMBLY A34

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P3896	B1	B1	R3743	A1	C1	R3751	A2	B1	R3757	A2	A2
P3899	B1	C1	R3745	A1	C2	R3752	A2	B2			
			R3747	A1	C2	R3753	A2	B2	S3748	A2	C2
R3741	A1	B2	R3748	A2	C2	R3755	A2	B2	S3756	A3	A2
R3742	A1	C1	R3749	A2	C2	R3756	A2	A2			

Partial A34 also shown on diagram 6.

ASSEMBLY A35

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C3802	G4	B1	P3790	H3	B1	R3803	H4	B1	S3780	A5	B1
			P3798	B4	B1	R3804	H4	B1			
DS3508	H4	C3				R3805	H4	B1	U3801	G4	A1
			R3802	G4	B1						

Partial A35 also shown on diagrams 6, 8 and 9.

ASSEMBLY A38

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P4113	H1	D1	P4190	H3	A7	P4198	B4	G7
P4177	B4	F7	P4196	B1	F7	P4199	B1	G7

Partial A38 also shown on diagrams 1, 2, 3, 4, 6, 7, 8 and 9.

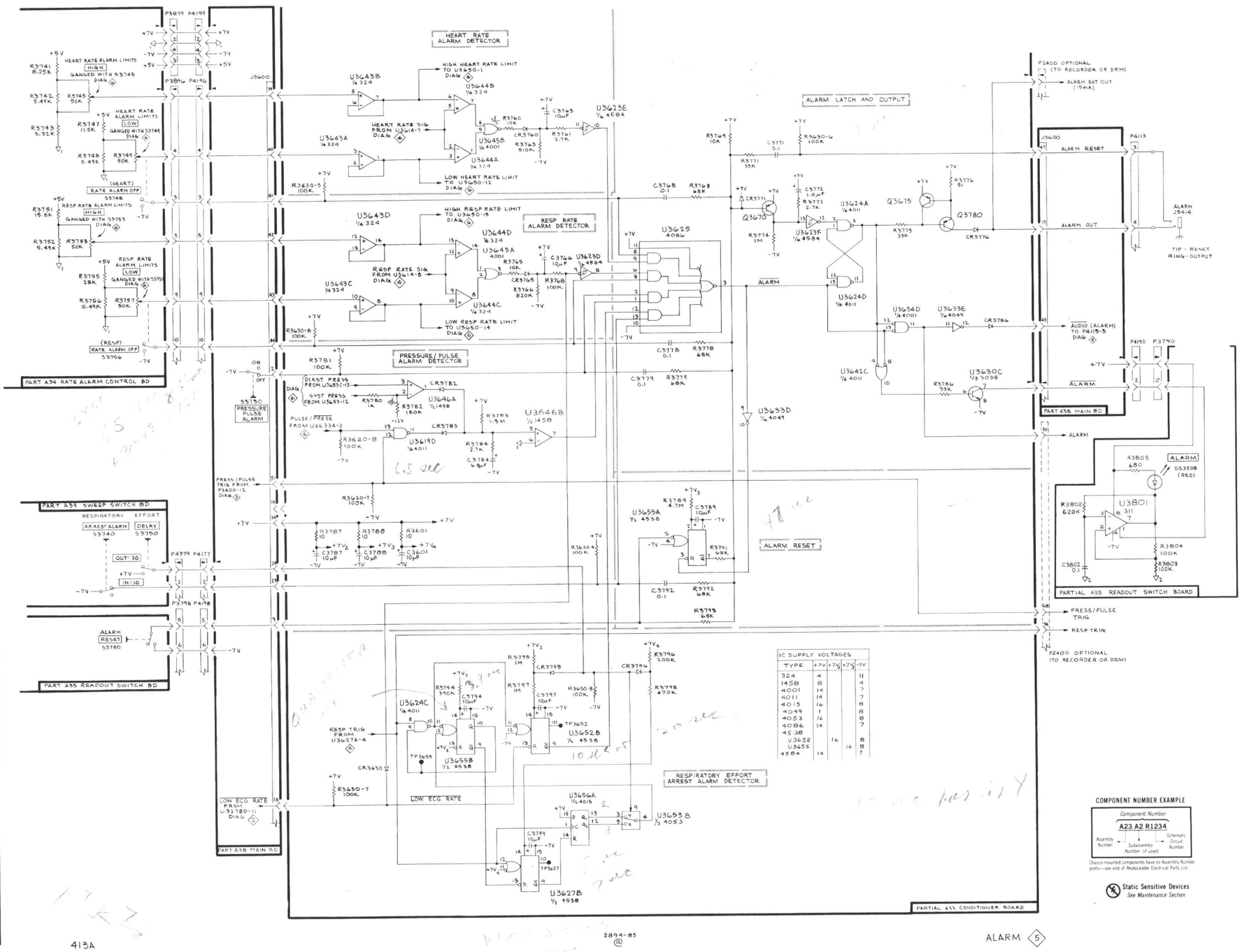
CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J5414	H2	CHASSIS

ASSEMBLY A39

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P4379	B4	E1	S3740	A4	B2	S3750	A4	A2	S3730	B3	D8

Partial A39 also shown on diagrams 8 and 9.


HEART RATE ALARM DETECTOR
RESP RATE ALARM DETECTOR
PRESSURE/PULSE ALARM DETECTOR
ALARM LATCH AND OUTPUT
RESPIRATORY EFFORT ARREST ALARM DETECTOR
LOW ECG RATE
ALARM RESET
PART A34 RATE ALARM CONTROL BD
PART A38 SWEEP SWITCH BD
PART A35 READOUT SWITCH BD
PART A38 MAIN BD
PARTIAL A35 READOUT SWITCH BOARD
PARTIAL A35 CONDITIONER BOARD
P2400 OPTIONAL (TO RECORDER OR DRM)
IC SUPPLY VOLTAGES
TYPE | +7V | +½ | +¾ | -7V
324 | 4 | | | 11
1458 | 8 | | | 4
4001 | 14 | | | 7
4011 | 14 | | | 7
4015 | 16 | | | 8
4049 | 1 | | | 8
4053 | 16 | | | 8
4086 | 14 | | | 7
4538 | | | | 8
U3652 | | 16 | | 8
U3655 | | | 16 | 7
4584 | 14 | | | 7
COMPONENT NUMBER EXAMPLE
Component Number
A23 A2 R1234
Assembly Number
Subassembly Number (if used)
Schematic Circuit Number
Chassis-mounted components have no Assembly Number prefix — see end of Replaceable Electrical Parts List
Static Sensitive Devices
See Maintenance Section

READOUT SWITCHING AND PRESSURE CONVERTERS DIAGRAM 6

ASSEMBLY A32

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P3400	B4	D5												

Partial A32 also shown on diagrams 3 and 8.

ASSEMBLY A33

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C3787	B6	C6	CR3882	C6	F4	R3839	E2	C3	R3890	E6	F6	U3637A	D5	F4
C3837	E2	C2				R3840	G1	G6	R3892	F5	D6	U3637B	C6	F4
C3851	G3	D3	J3600	B1	A4	R3843	G3	B4	R3893	F5	C6	U3637C	B5	F4
C3861	B5	F3	J3600	I2	A4	R3845	G3	B4	R3895	G5	C6	U3637D	C6	F4
C3862	B5	E4				R3846	G3	B3				U3638A	C5	G4
C3865	D5	G6	P2400	I1	C1	R3848	G3	B3	TP3650	F5	B6	U3638B	C5	G4
C3867	D5	F3	P2400	I6	C1	R3851	G2	D3	TP3661	A6	G6	U3638C	C6	G4
C3870	B6	F4	P3600	A5	A4	R3852	H2	D3				U3638D	D5	G4
C3873	C5	G6				R3854	H2	E4	U3613	A5	C2	U3640	D3	B5
C3874	D5	G6	Q3852	H3	D4	R3855	H3	D2	U3615C	A6	E2	U3641	F4	B5
C3876	D5	G5				R3856	C4	D6	U3620B	C4	B3	U3642A	C2	C5
C3877	D5	G5	R3620	B6	A3	R3857	C4	G4	U3621A	D1	B3	U3642B	G5	C5
C3879	A6	A6	R3620	C3	A3	R3858	B5	E4	U3621D	D2	B3	U3642D	E2	C5
C3881	B6	G3	R3620	C4	A3	R3859	B6	E3	U3623A	E2	C3	U3647A	E5	F5
C3884	C6	G4	R3620	D4	A3	R3860	B6	E4	U3624B	G2	D3	U3647B	E6	F5
C3885	C6	G5	R3630	D2	A4	R3861	B5	E4	U3630D	G3	B4	U3647C	D6	F5
C3885	D6	G5	R3640	C1	A5	R3862	B5	F4	U3630E	G3	B4	U3648A	C5	G5
C3887	D6	F6	R3640	C2	A5	R3863	C5	F4	U3631	F2	B4	U3648B	C6	G5
C3889	E6	F6	R3640	C3	A5	R3865	D5	F4	U3632	H4	C4	U3648C	D5	G5
C3895	G5	C6	R3660	B6	A6	R3867	D5	F4	U3633A	C3	C4	U3648D	D6	G5
			R3660	C3	A6	R3868	D5	F4	U3633B	G4	C4	U3649B	G1	G5
CR3834	D1	B3	R3676	D5	G4	R3870	B5	F4	U3633C	C2	C4	U3649F	C4	G5
CR3836	D2	B3	R3787	A6	C6	R3871	B5	F4	U3634A	F5	D4	U3650	D1	B6
CR3848	G3	B3	R3830	D2	B3	R3877	D5	G4	U3634B	D2	D4	U3652A	G5	C6
CR3849	G2	D3	R3831	D1	C4	R3878	E5	F6	U3634C	G4	D4	U3653A	F5	C6
CR3856	C2	D6	R3833	D1	B5	R3880	B6	G4	U3636A	B6	E4	U3653C	E5	C6
CR3858	B5	E4	R3834	E1	C3	R3881	B6	G4	U3636B	B6	E4	U3656B	G4	E6
CR3859	B5	E4	R3836	E2	C2	R3887	D6	F6	U3636C	C5	E4			
CR3872	C5	F4	R3837	E2	C2	R3889	D6	F6	U3636D	C5	E4			

Partial A33 also shown on diagrams 1, 2, 3, 4, 5 and 9.

ASSEMBLY A34

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
CR3827	B1	B1	P3896	B1	B1	S3745	A1	C1	S3753	A1	B1			
CR3828	B1	A1				S3749	A1	C1	S3757	A1	A1			

Partial A34 also shown on diagram 5.

ASSEMBLY A35

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
CR3821	B2	C1	P3795	B2	C1	S3820	A2	B2						
CR3822	B2	C1												

Partial A35 also shown on diagrams 5, 8 and 9.

ASSEMBLY A37

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS4050	I3	A1	DS4060	I3	A1	P2356	I3	A2						

Partial A37 also shown on diagrams 4 and 7.

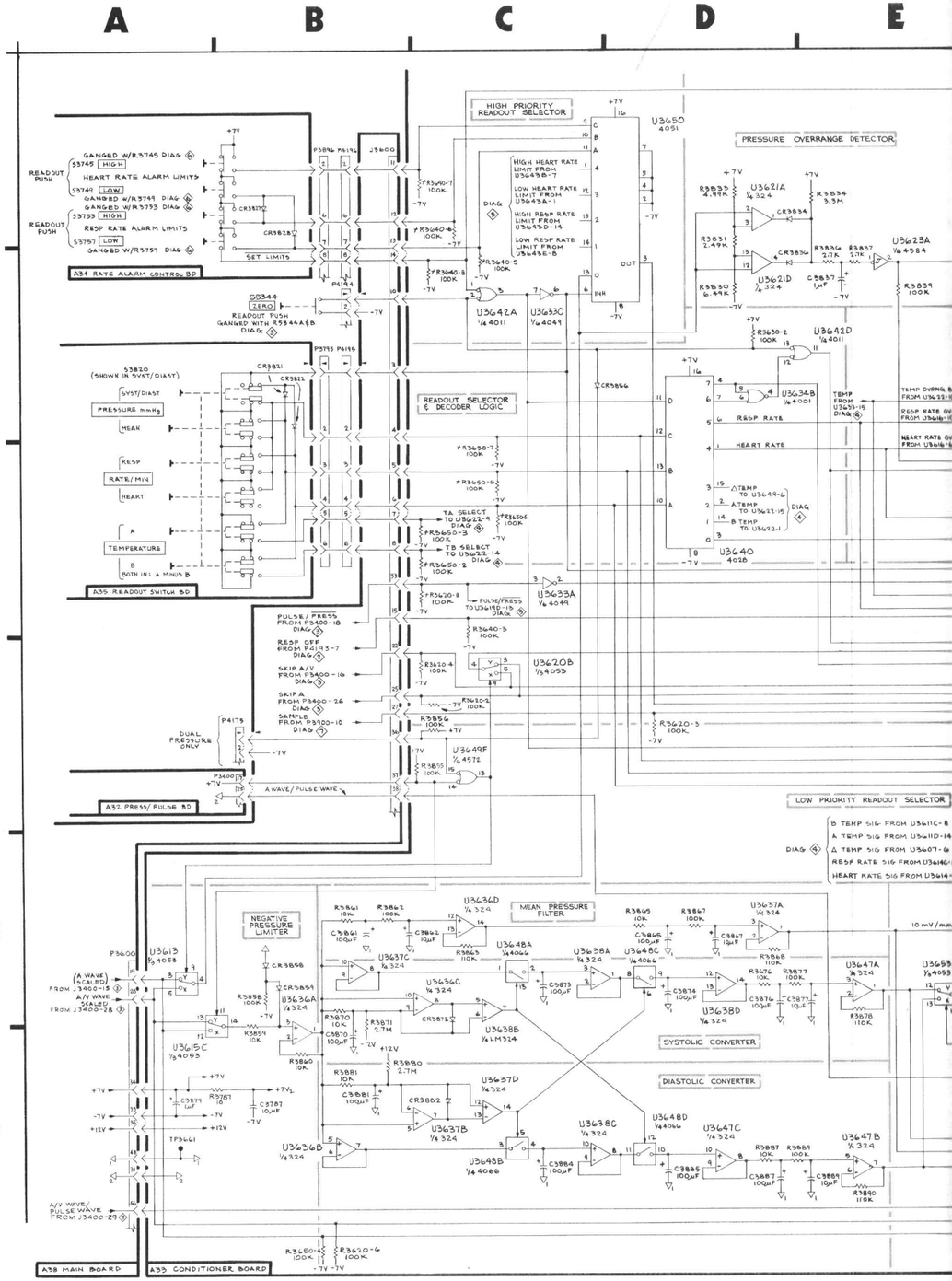
ASSEMBLY A38

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P4175	B4	F5	P4192	I3	B7	P4194	B2	D7	P4195	B2	D7	P4196	B1	F7

Partial A38 also shown on diagrams 1, 2, 3, 4, 5, 7, 8 and 9.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
S5344	B2	CHASSIS												



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CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
U3637A	D5	F4
U3637B	C6	F4
U3637C	B5	F4
U3637D	C6	F4
U3638A	C5	G4
U3638B	C5	G4
U3638C	C6	G4
U3638D	D5	G4
U3640	D3	B5
U3641	F4	B5
U3642A	C2	C5
U3642B	G5	C5
U3642D	E2	C5
U3647A	E5	F5
U3647B	E6	F5
U3647C	D6	F5
U3648A	C5	G5
U3648B	C6	G5
U3648C	D5	G5
U3648D	D6	G5
U3649B	G1	G5
U3649F	C4	G5
U3650	D1	B6
U3652A	G5	C6
U3653A	F5	C6
U3653C	E5	C6
U3656B	G4	E6

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P4196	B1	F7

IC SUPPLY VOLTAGES

TYPE	+7V	+7½	-7V
324	4		11
4001	14		7
4011	14		7
4015	16		8
4049	1		8
4051	16		8
4063	16		8
4372	16		8
4538		16	8
4584	14		7

HIGH PRIORITY READOUT SELECTOR

PRESSURE OVERRANGE DETECTOR

OVERRANGE GATE

RAPID UPDATE TRIGGER GENERATOR

READOUT SELECTOR & DECODER LOGIC

DIGITAL DISPLAY UNITS LOGIC

LOW PRIORITY READOUT SELECTOR

NEGATIVE PRESSURE LIMITER

MEAN PRESSURE FILTER

SYSTOLIC CONVERTER

DIASTOLIC CONVERTER

BLANKING GATE

BLANKING TIMING

SIGN ENABLE GATE

SYSTOLIC/DIASTOLIC SELECTOR

P2400 OPTIONAL (TO RECORDER OR DRM)

P2400 OPTIONAL (TO RECORDER OR DRM)

NOTE: * 0.1% TC RESISTOR

COMPONENT NUMBER EXAMPLE

Component Number A23 A2 R1234 — Assembly Number, Subassembly Number, Schematic Circuit Number, Subassembly Number (if used)

Chassis mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Static Sensitive Devices See Maintenance Section

A34 RATE ALARM CONTROL BD

A35 READOUT SWITCH BD

A32 PRESS/PULSE BD

A38 MAIN BOARD

A33 CONDITIONER BOARD

413A

2894-86

READOUT SWITCHING AND PRESSURE CONVERTERS ⟨6⟩

PRESSURE CONVERTERS ⟨6⟩

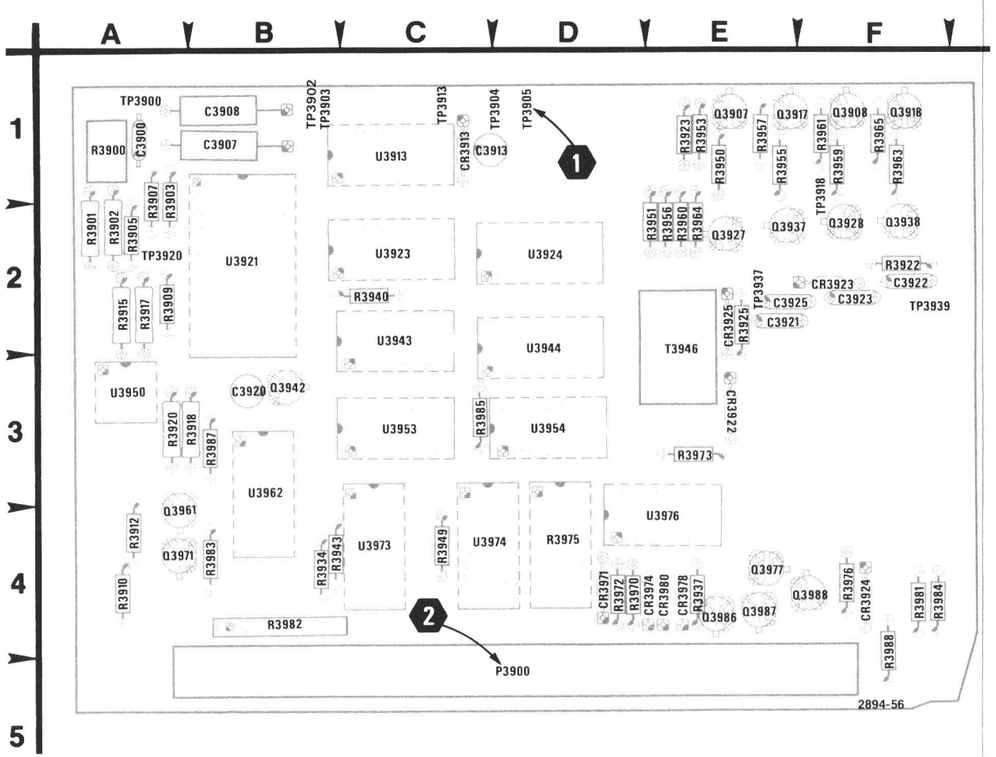


Fig. 8-12. A36-DVM board component locations.

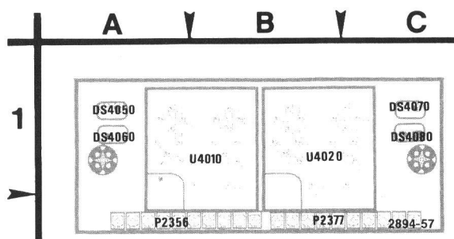
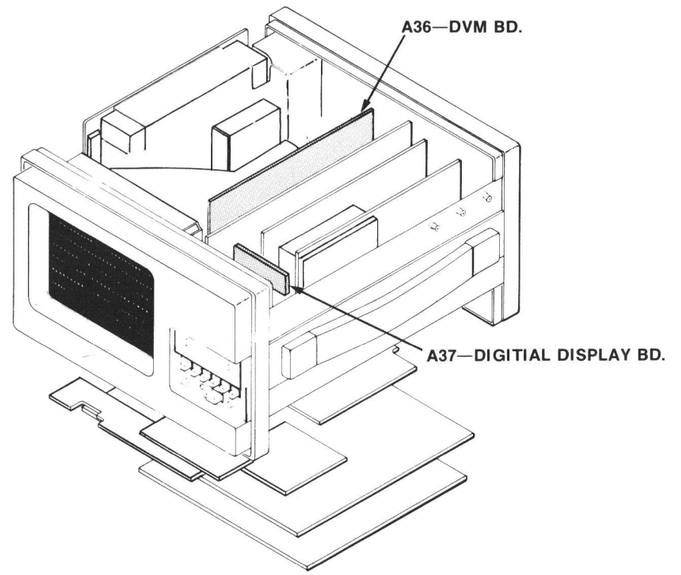


Fig. 8-13. A37-Digital Display board component locations.



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number

A23 A2 R1234

Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

DV

ASSEMBLY A36

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION
C3900	B2	A1	Q3977	F4
C3907	B3	B1	Q3986	E4
C3908	B3	B1	Q3987	F4
C3913	B3	D1	Q3988	F3
C3920	B3	B3		
C3921	B4	E2	R3900	B2
C3922	B4	F2	R3901	B2
C3923	B4	F2	R3902	B2
C3925	B4	E2	R3903	B2
			R3905	B2
CR3913	B3	C1	R3907	B2
CR3922	B4	E3	R3909	B3
CR3923	B4	F2	R3910	B3
CR3924	B4	F4	R3912	B3
CR3925	B4	E2	R3915	B3
CR3971	F3	D4	R3917	B3
CR3974	F4	E4	R3918	B3
CR3978	F4	E4	R3920	B3
CR3980	E4	E4	R3922	B4
			R3923	B4
P3900	A2	D5	R3925	B4
P3900	F2	D5	R3934	B5
			R3937	B5
Q3907	E2	E1	R3940	B5
Q3908	F2	F1	R3943	B4
Q3917	F2	F1	R3949	D3
Q3918	F2	F1	R3950	E1
Q3927	E1	E2	R3951	E1
Q3928	E2	F2	R3953	E1
Q3937	E2	F2	R3955	E2
Q3938	E2	F2	R3956	E2
Q3942	E5	B3	R3957	E2
Q3961	B3	A4	R3959	E2
Q3971	F5	A4	R3960	E2

ASSEMBLY A37

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION
DS4050	G2	A1	P2356	G1
DS4060	G2	A1	P2356	G2
			P2356	H2

Partial A37 also shown on diagrams 4 and 6.

ASSEMBLY A38

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION
P4173	G2	C7	P4192	G1

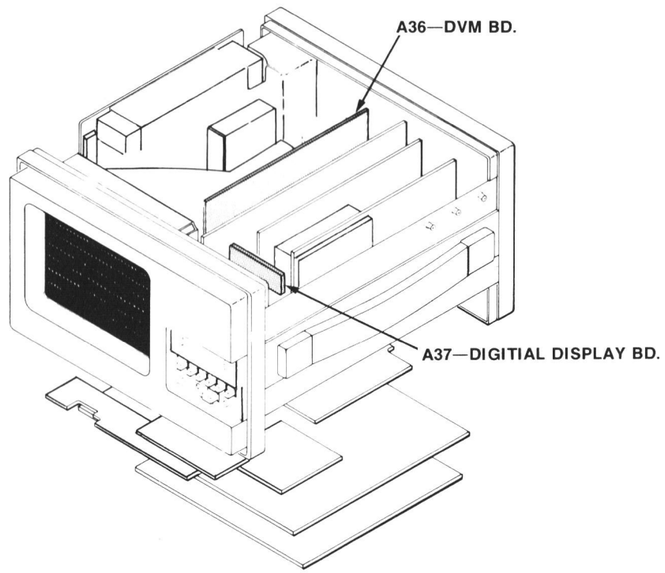
Partial A38 also shown on diagrams 1, 2, 3, 4, 5, 6, 8 and 9.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION
DS4070	H2	CHASSIS	DS4080	H2

F

Q3918
R3965
R3963
Q3938
R3922
C3922
TP3939
R3981
R3984
R3988
8094-56



DVM DIAGRAM 7

ASSEMBLY A36

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C3900	B2	A1
C3907	B3	B1
C3908	B3	B1
C3913	B3	D1
C3920	B3	B3
C3921	B4	E2
C3922	B4	F2
C3923	B4	F2
C3925	B4	E2
CR3913	B3	C1
CR3922	B4	E3
CR3923	B4	F2
CR3924	B4	F4
CR3925	B4	E2
CR3971	F3	D4
CR3974	F4	E4
CR3978	F4	E4
CR3980	E4	E4
P3900	A2	D5
P3900	F2	D5
Q3907	E2	E1
Q3908	F2	F1
Q3917	F2	F1
Q3918	F2	F1
Q3927	E1	E2
Q3928	E2	F2
Q3937	E2	F2
Q3938	E2	F2
Q3942	E5	B3
Q3961	B3	A4
Q3971	F5	A4
Q3977	F4	E4
Q3986	E4	E4
Q3987	F4	E4
Q3988	F3	F4
R3900	B2	A1
R3901	B2	A2
R3902	B2	A2
R3903	B2	A2
R3905	B2	A2
R3907	B2	A2
R3909	B3	A2
R3910	B3	A4
R3912	B3	A4
R3915	B3	A2
R3917	B3	A2
R3918	B3	B3
R3920	B3	A3
R3922	B4	F2
R3923	B4	E1
R3925	B4	E2
R3934	B5	B4
R3937	B5	E4
R3940	B5	C2
R3943	B4	C4
R3949	D3	C4
R3950	E1	E1
R3951	E1	E2
R3953	E1	E1
R3955	E2	E1
R3956	E2	E2
R3957	E2	E1
R3959	E2	F1
R3960	E2	E2
R3961	F2	F1
R3963	E2	F1
R3964	E2	E2
R3965	F2	F1
R3970	F3	D4
R3972	F3	D4
R3973	E3	E3
R3975	E2	D4
R3975	E4	D4
R3975	F1	D4
R3975	F3	D4
R3975	F4	D4
R3976	F4	F4
R3981	F4	F4
R3982D	B4	B4
R3982E	B5	B4
R3982F	B5	B4
R3982G	B4	B4
R3983	E5	B4
R3984	E5	F4
R3985	E5	C3
R3987	E5	B3
R3988	F5	F4
T3946	B4	E3
TP3900	B2	A1
TP3902	C3	B1
TP3903	C2	B1
TP3904	B4	D1
TP3905	E4	D1
TP3913	B3	C1
TP3918	B4	F1
TP3920	B2	A2
TP3937	B4	E2
TP3939	B4	F2
U3913	D3	C1
U3921	C2	B2
U3923	D3	C2
U3923A	E5	C2
U3923D	E4	C2
U3924A	C1	D2
U3924B	D2	D2
U3943	C2	C2
U3944A	D2	D3
U3944B	D2	D3
U3950A	B3	A3
U3950B	B3	A3
U3953A	D2	C3
U3953B	C4	C3
U3954A	D4	D3
U3954B	D4	D3
U3962A	C4	B3
U3962B	C4	B3
U3973A	B4	C4
U3973B	F4	C4
U3973C	B5	C4
U3973D	D4	C4
U3973E	D4	C4
U3973F	E3	C4
U3974	D3	D4
U3976A	E4	E4
U3976B	E4	E4
U3976D	E4	E4

ASSEMBLY A37

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS4050	G2	A1
DS4060	G2	A1
P2356	G1	A2
P2356	G2	A2
P2356	H2	A2
P2377	G2	B1
U4010	G1	B1
U4020	H1	B1

Partial A37 also shown on diagrams 4 and 6.

ASSEMBLY A38

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P4173	G2	C7
P4192	G1	B7
P4192	G2	B7
P4192	H2	B7

Partial A38 also shown on diagrams 1, 2, 3, 4, 5, 6, 8 and 9.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS4070	H2	CHASSIS
DS4080	H2	CHASSIS

Static Sensitive Devices
See Maintenance Section

PONENT NUMBER EXAMPLE

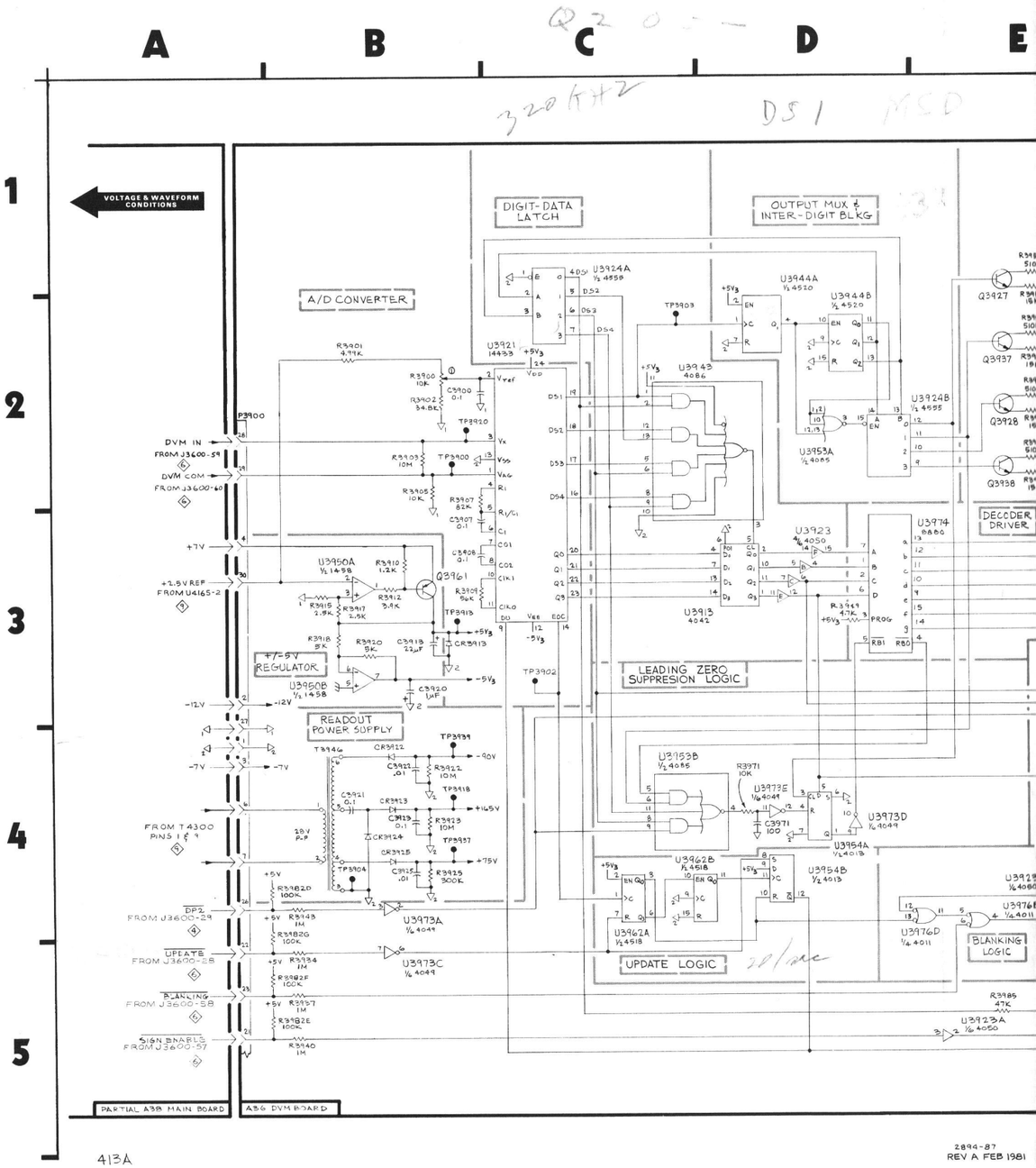
Component Number
A23 A2 R1234
bly — Subassembly Number (if used)
Schematic Circuit Number

mounted components have no Assembly Number
e end of Replaceable Electrical Parts List.

@

DVM BOARD ⑦

WAVEFORM NUMBER	DESCRIPTION	CONDITIONS	IDEALIZED WAVEFORM
1	TP3905 BLANKING	PRESSURE TRANSDUCER CONNECTED. 125 mmHg RANGE SELECTED. PRESSURE ZERO ADJUSTED FOR 0 mmHg TRACE ON CRT (NOT OVERRANGE)	≈1 SEC, ≈100 ms, +5 V, 0 V, ≈50 ms, +5 V, −7 V
2	P3900 Pin 10 SAMPLE	ABOVE	



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REV A FEB 1981

A B C D E F G H

1 2 3 4 5

VOLTAGE & WAVEFORM CONDITIONS

DIGIT-DATA LATCH

OUTPUT MUX & INTER-DIGIT BLKG

ANODE DRIVERS

A/D CONVERTER

DECODER DRIVER

LEADING ZERO SUPPRESION LOGIC

+7V=5V REGULATOR

READOUT POWER SUPPLY

UPDATE LOGIC

BLANKING LOGIC

SIGN, DECIMAL & ½ DIGIT DRIVERS

SAMPLE OUTPUT

A37 DIGITAL DISPLAY BD

U4010

U4020

DVM IN FROM U3600-59

DVM COM FROM U3600-60

+2.5V REF FROM U4165-2

FROM T4300 PINS 1 & 9

DP2 FROM U3600-29

UPDATE FROM U3600-58

BLANKING FROM U3600-58

SIGN ENABLE FROM U3600-57

FROM U3600-20 DIAG

FROM U3600-54 DIAG

SAMPLE TO P3600-27

IC SUPPLY VOLTAGES

TYPE	+7V	-7V	+5V	½	-12V
4049			1	8	
4050			1	8	
4085			14	7	
4086			14	7	
4555			16	8	
4518			16	8	
4013			14	7	
4011			14	7	
4520			16	8	
4042			16	8	
1458	8				4
8880			16	8	

* RESISTOR PACK R3975

* RESISTOR PACK R3982

7-100K

COMPONENT NUMBER EXAMPLE

Component Number: A23 A2 R1234

Assembly Number → A23 | Subassembly Number (if used) A2 | Schematic Circuit Number R1234

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Static Sensitive Devices — See Maintenance Section

PARTIAL A38 MAIN BOARD

A36 DVM BOARD

PARTIAL A38 MAIN BOARD

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2894-87
REV A FEB 1981

DVM 7

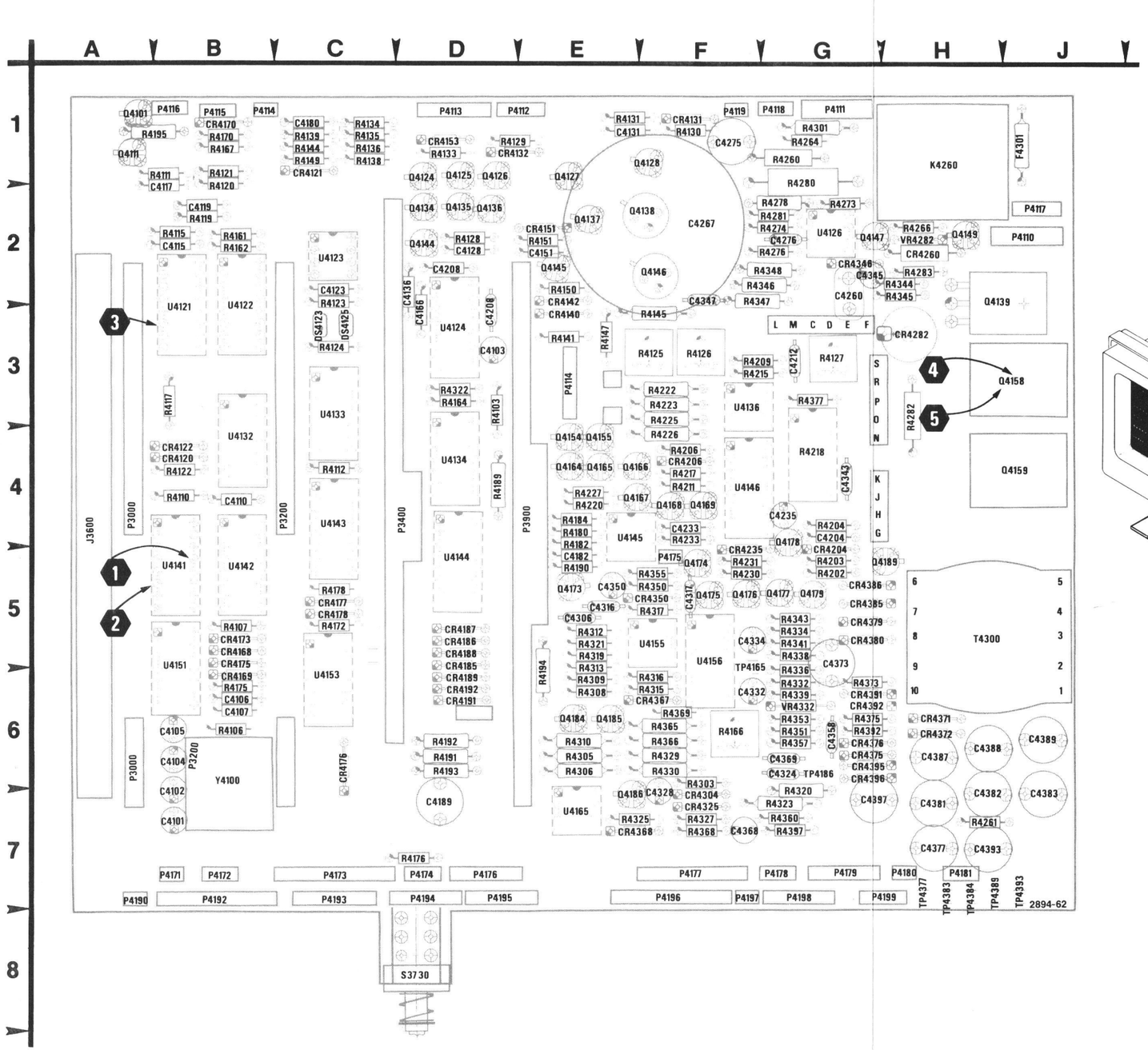
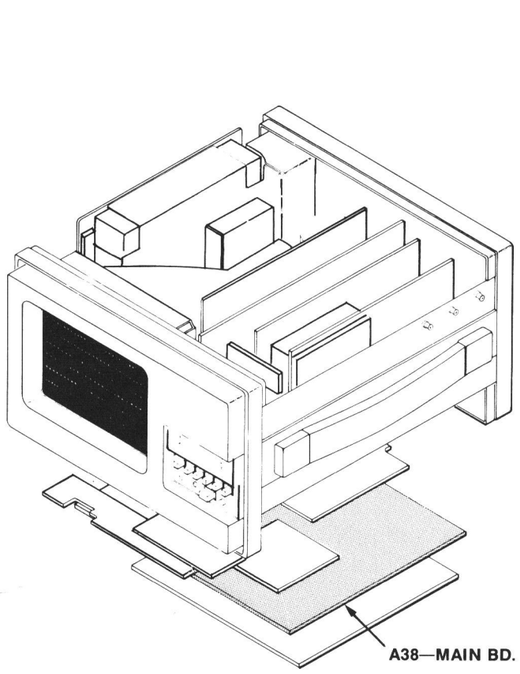
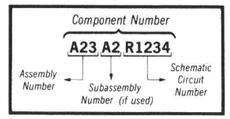


Fig. 8-14. A38-Main board component locations.



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

HORIZ AN

ASSEMBLY A30

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCU NUMB
P3000	B1	C5				P340

Partial A30 also shown on diagram 1. *Partial A*

ASSEMBLY A38

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCU NUMB
C4101	A1	B7	CR4170	E3	B1	P417
C4102	A1	B6	CR4173	D4	B5	P418
C4103	A1	D3	CR4175	B5	B5	P419
C4104	A1	B6	CR4176	B5	C6	P419
C4105	A1	B6	CR4177	B5	C5	P419
C4106	B1	B6	CR4178	B5	C5	
C4107	C1	B6	CR4185	D4	D5	Q410
C4110	D1	B4	CR4186	D4	D5	Q411
C4115	F1	B2	CR4187	D5	D5	Q412
C4117	F1	B1	CR4188	D5	D5	Q412
C4119	F1	B2	CR4189	E5	D6	Q412
C4123	F2	C2	CR4191	D5	D6	Q412
C4128	G1	D2	CR4192	D5	D6	Q412
C4131	G1	E1	CR4204	F3	G4	Q413
C4136	G2	D2	CR4206	G3	F4	Q413
C4151	G3	E2	CR4235	F4	F4	Q413
C4166	D3	D2				Q413
C4180	D5	C1	DS4123	F2	C3	Q413
C4182	D5	E5	DS4125	F2	C3	Q414
C4189	E5	D7				Q414
C4204	F4	G4	J3600	A1	A4	Q414
C4208	G3	D2				Q415
C4212	G4	G3	P3000	B1	A4	Q415
C4233	F4	F4	P3200	B1	C4	Q416
C4235	G5	G4	P3400	B1	D4	Q416
			P3900	A1	E4	Q416
CR4120	F2	B4	P4112	C4	D1	Q416
CR4121	F1	C1	P4113	A4	D1	Q416
CR4122	F2	B4	P4115	C5	B1	Q416
CR4131	G1	F1	P4116	F5	B1	Q417
CR4132	G1	D1	P4119	E1	F1	Q417
CR4140	H2	E3	P4144	H2	E3	
CR4142	H2	E2	P4154	E5	D6	R410
CR4151	G3	E2	P4171	C5	B7	R410
CR4153	G3	D1	P4171	C5	B7	R410
CR4168	D3	B5	P4177	E4	F7	R411
CR4169	D3	B5	P4177	F4	F7	R411

Partial A38 also shown on diagrams 1, 2, 3, 4, 5, 6, 7 and 9.

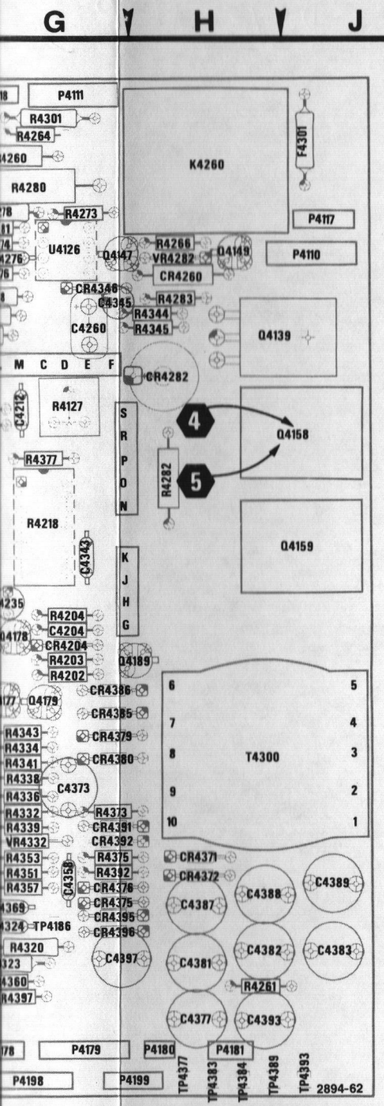
ASSEMBLY A39

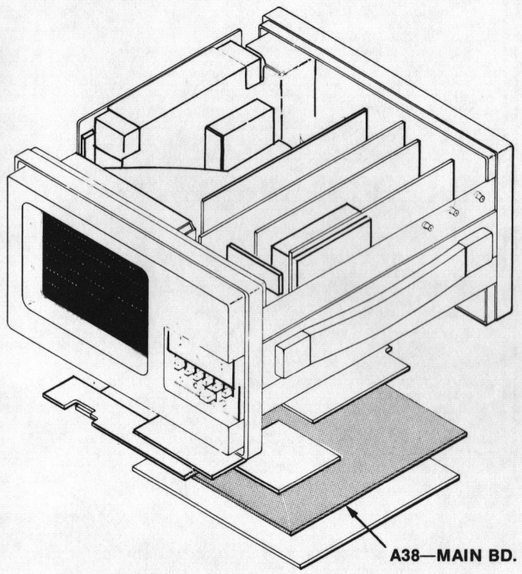
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCU NUMB
P4379	E4	E1	R4240	E4	D1	R424
P4379	F4	E1	R4241	E4	D1	R424

Partial A39 also shown on diagrams 5 and 9.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCU NUMB
DS5312	C5	CHASSIS	J5412	A5	CHASSIS	L542
DS5322	C5	CHASSIS	J5414	A5	CHASSIS	LS541
J5410	A4	CHASSIS	L5420A	H2	CHASSIS	

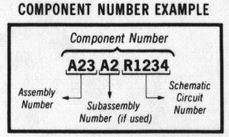




A38—MAIN BD.

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

HORIZ AND VERT AMPLIFIERS DIAGRAM 8

ASSEMBLY A30

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P3000	B1	C5			

Partial A30 also shown on diagram 1.

ASSEMBLY A32

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P3400	B1	D5			

Partial A32 also shown on diagrams 3 and 6.

ASSEMBLY A35

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS4198	C5	B3	P3798	C5	B1

Partial A35 also shown on diagrams 5, 6 and 9.

ASSEMBLY A38

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C4101	A1	B7	CR4170	E3	B1	P4178	D5	G7	R4112	D2	C4	R4176	B5	D7	U4122B	C2	B2
C4102	A1	B6	CR4173	D4	B5	P4180	D5	H7	R4115	E1	B2	R4178	B5	C5	U4122C	C2	B2
C4103	A1	D3	CR4175	B5	B5	P4193	C5	C7	R4117	F1	B3	R4180	D5	E4	U4122C	E2	B2
C4104	A1	B6	CR4176	B5	C6	P4197	E4	F7	R4119	F1	B2	R4182	D5	E4	U4122D	C3	B2
C4105	A1	B6	CR4177	B5	C5	P4198	C5	G7	R4120	F2	B1	R4184	D5	E4	U4122F	C2	B2
C4106	B1	B6	CR4178	B5	C5				R4121	F2	B1	R4189	E4	D4	U4123	F2	C2
C4107	C1	B6	CR4185	D4	D5	Q4101	E3	A1	R4122	F2	B4	R4190	E5	E5	U4124A	D3	D3
C4110	D1	B4	CR4186	D4	D5	Q4111	E3	A1	R4123	F2	C2	R4191	E5	D6	U4124B	G3	D3
C4115	F1	B2	CR4187	D5	D5	Q4124	F2	D1	R4124	F2	C3	R4192	E5	D6	U4132A	E1	B4
C4117	F1	B1	CR4188	D5	D5	Q4125	F2	D1	R4125	H2	F3	R4193	E5	D6	U4132B	E1	B4
C4119	F1	B2	CR4189	E5	D6	Q4126	G1	D1	R4126	G4	F3	R4194	E5	E5	U4132C	D1	B4
C4123	F2	C2	CR4191	D5	D6	Q4127	G1	E1	R4127	G3	G3	R4195	E5	B1	U4132D	D1	B4
C4128	G1	D2	CR4192	D5	D6	Q4128	G1	F1	R4128	G1	D2	R4202	F3	G5	U4133A	E2	C3
C4131	G1	E1	CR4204	F3	G4	Q4134	G2	D2	R4129	F1	D1	R4203	F3	G5	U4133B	E2	C3
C4136	G2	D2	CR4206	G3	F4	Q4135	F2	D2	R4130	G1	F1	R4204	F4	G4	U4133C	C3	C3
C4151	G3	E2	CR4235	F4	F4	Q4136	G3	D2	R4131	G1	E1	R4206	G3	F4	U4133D	C3	C3
C4166	D3	D2				Q4137	G3	E2	R4133	G2	D1	R4208	G3	D2	U4134	F3	D4
C4180	D5	C1	DS4123	F2	C3	Q4138	G2	F2	R4134	G2	C1	R4209	G3	F3	U4134A	E3	D4
C4182	D5	E5	DS4125	F2	C3	Q4144	G2	D2	R4135	G2	C1	R4211	G3	F4	U4136A	G5	F3
C4189	E5	D7				Q4145	G2	E2	R4136	G2	C1	R4215	G4	F3	U4136B	G4	F3
C4204	F4	G4	J3600	A1	A4	Q4146	G2	F2	R4138	G2	C1	R4217	G3	F4	U4141A	C1	B5
C4208	G3	D2				Q4154	H5	E4	R4139	G2	C1	R4218	G4	G4	U4141B	C1	B5
C4212	G4	G3	P3000	B1	A4	Q4155	H4	E4	R4141	H2	E3	R4220	G4	E4	U4142A	C1	B5
C4233	F4	F4	P3200	B1	C4	Q4164	H5	E4	R4144	G2	C1	R4222	G4	F3	U4142B	B1	B5
C4235	G5	G4	P3400	B1	D4	Q4165	H4	E4	R4145	H2	F3	R4223	H4	F3	U4143	D3	C4
			P3900	A1	E4	Q4166	D5	E4	R4147	H2	E3	R4225	H4	F3	U4144	D4	D5
CR4120	F2	B4	P4112	C4	D1	Q4167	D5	E4	R4149	F2	C1	R4226	H4	F4	U4145	D5	E4
CR4121	F1	C1	P4113	A4	D1	Q4168	F4	F4	R4150	G3	E2	R4227	G5	E4	U4146	G4	F4
CR4122	F2	B4	P4115	C5	B1	Q4169	G3	F4	R4151	G3	E2	R4230	F4	F5	U4151A	D1	B5
CR4131	G1	F1	P4116	F5	B1	Q4173	E5	E5	R4161	C2	B2	R4231	F4	F5	U4151B	D1	B5
CR4132	G1	D1	P4119	E1	F1	Q4178	F3	G4	R4162	C2	B2	R4233	F4	F4	U4151C	C1	B5
CR4140	H2	E3	P4144	H2	E3				R4164	C3	D3				U4151D	D1	B5
CR4142	H2	E2	P4154	E5	D6	R4103	A1	D3	R4166	D3	F6	TP4142	D1	C5	U4153A	E3	C5
CR4151	G3	E2	P4171	C5	B7	R4106	C1	B6	R4167	E3	B1				U4153B	F3	C5
CR4153	G3	D1	P4171	C5	B7	R4107	C1	B5	R4170	E3	B1	U4121A	F1	B2	U4153C	D3	C5
CR4168	D3	B5	P4177	E4	F7	R4110	D1	B4	R4172	E4	C5	U4121B	F1	B2			
CR4169	D3	B5	P4177	F4	F7	R4111	E3	B1	R4175	B5	B6	U4122A	C2	B2	Y4100	C1	B6

Partial A38 also shown on diagrams 1, 2, 3, 4, 5, 6, 7 and 9.

ASSEMBLY A39

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P4379	E4	E1	R4240	E4	D1	R4242	F4	D1	S4250	E5	C2						
P4379	F4	E1	R4241	E4	D1	R4243	F4	D1									

Partial A39 also shown on diagrams 5 and 9.

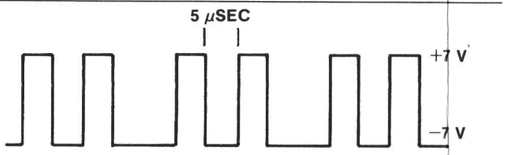
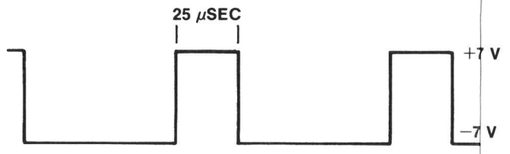
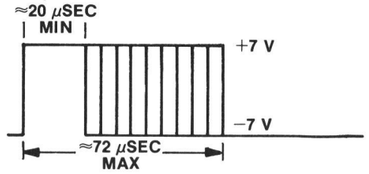
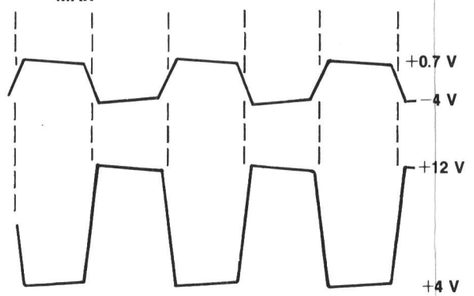
CHASSIS MOUNTED PARTS

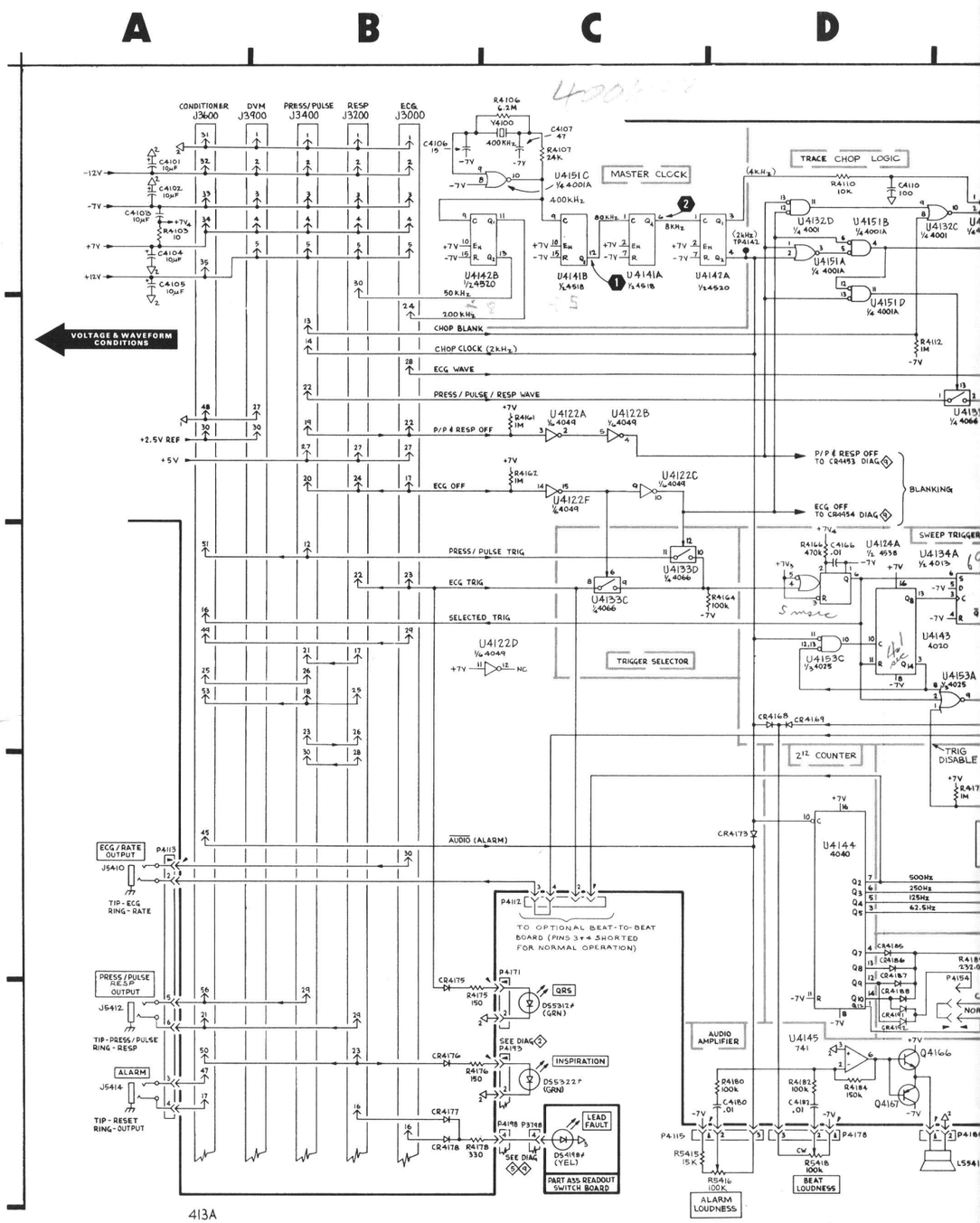
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS5312	C5	CHASSIS	J5412	A5	CHASSIS	L5420B	H4	CHASSIS	R5416	D5	CHASSIS	VR4191	F5	CHASSIS			
DS5322	C5	CHASSIS	J5414	A5	CHASSIS	LS5419	D5	CHASSIS	R5418	D5	CHASSIS	VR4193	F5	CHASSIS			
J5410	A4	CHASSIS	L5420A	H2	CHASSIS				RT5420	H4	CHASSIS	VR4195	F5	CHASSIS			

tions.

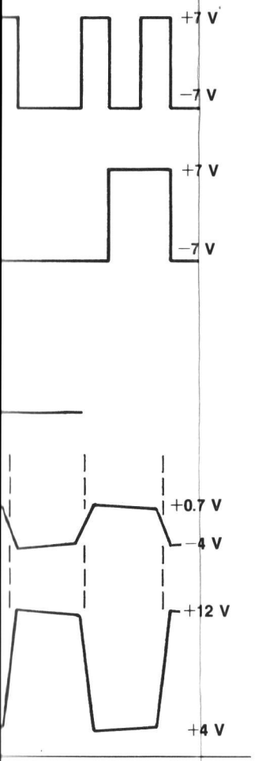
@

MAIN BOARD ◇8◇9

WAVEFORM NUMBER	DESCRIPTION	CONDITIONS	IDEALIZED WAVEFORM
1	U4141B Pin 12 80 kHz	FOR BEST VIEWING TRIGGER TEST OSCILLOSCOPE ON ⓶	
2	U4141A Pin 6 8 kHz		
3	U4121A Pin 6 BOOST	ECG, RESP, & PRESSURE/PULSE ON CRT	
4	Q4158 BASE POWER SUPPLY CONVERTER	POWERED BY AC LINE	
5	Q4158 COLLECTOR POWER SUPPLY CONVERTER	ABOVE	



FORM



A B C D E F G H

1 2 3 4 5

VOLTAGE & WAVEFORM CONDITIONS

CONDITIONER J3600 · DVM J3900 · PRESS/PULSE J3400 · RESP J3200 · ECG J3000

MASTER CLOCK · TRACE CHOP LOGIC · VERTICAL AMPLIFIER WITH BOOST · SWEEP TRIGGER · SWEEP GENERATOR · TRIGGER SELECTOR · 2^12 COUNTER · AUDIO AMPLIFIER · HORIZONTAL AMPLIFIER · PARTIAL A39 SWEEP SWITCH BOARD · BLANKING · ECG LEAD/RESP TEST

CHOP BLANK · CHOP CLOCK (2kHz) · ECG WAVE · PRESS/PULSE/RESP WAVE · P/P & RESP OFF · ECG OFF · PRESS/PULSE TRIG · ECG TRIG · SELECTED TRIG · AUDIO (ALARM)

P/P & RESP OFF TO CR4453 DIAG 9 · ECG OFF TO CR4454 DIAG 9 · CHOP BLANK TO CR4451 DIAG 9 · RETRACE BLANK TO CR4452 DIAG 9

IC SUPPLY VOLTAGES

TYPE	+7V	+7V4	-7V
741	7	4	4
1458	8	4	4
4001	14	7	7
4013	14	4	7
4020	16	8	8
4049	1	8	8
4066	14	7	7
4518	16	8	8
4520	16	8	8
4538	16	8	8

NOTE
* SHIPPED WITHOUT R4240, R4241 FOR FREE RUNNING SWEEP AT 12.5 & 25 mm/SEC
** REMOVE TO FREE RUN SWEEP
✓ FRONT PANEL INDICATOR
✓✓ COMPONENTS OF SAME ASSY

COMPONENT NUMBER EXAMPLE
Component Number: A23 A2 R1234
(Assembly Number – Subassembly Number (if used) – Schematic Circuit Number)
Chassis mounted components have no Assembly Number prefix – see end of Replaceable Electrical Parts List.

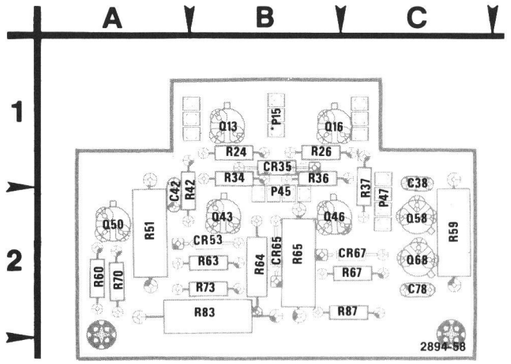
Static Sensitive Devices
See Maintenance Section

413A

2894-68 REV A FEB 1981

A38 PARTIAL MAIN BOARD

HORIZ AND VERT AMPLIFIERS 8



*on back of board

Fig. 8-15. A20-Battery conditioner board component locations.

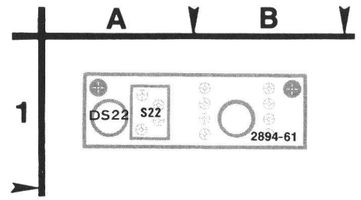
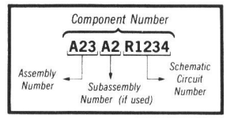


Fig. 8-17. A22-Start switch board component locations.

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Static Sensitive Devices
See Maintenance Section

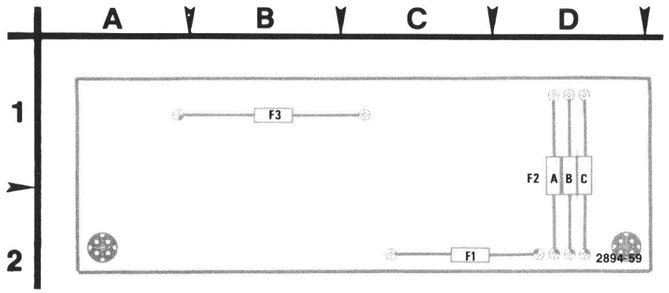


Fig. 8-16. A21-Battery board component locations.

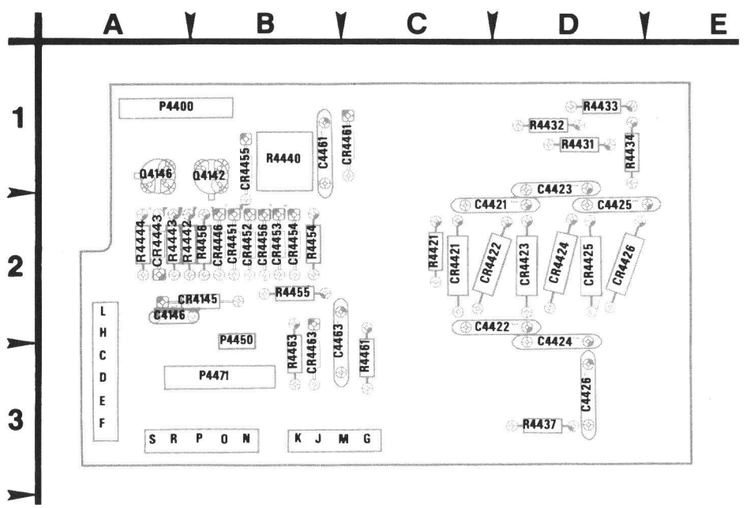
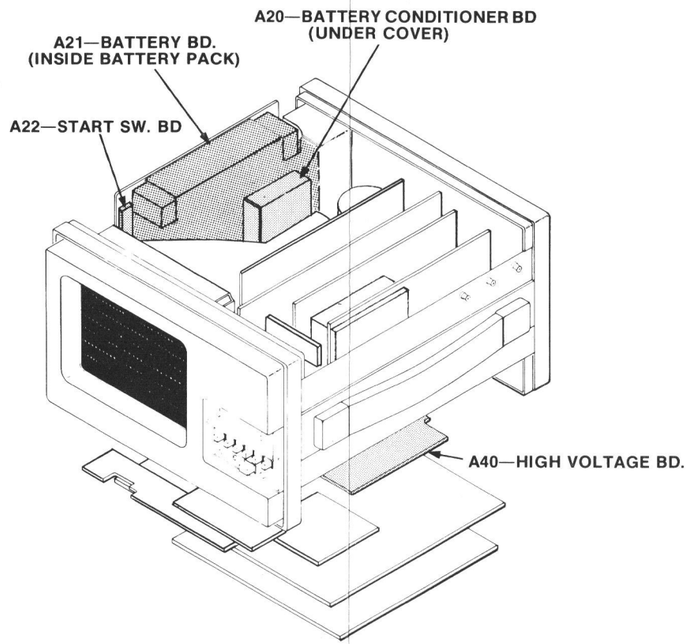


Fig. 8-18. A40-High-Voltage board component locations.



POWER SUPPLY AND CRT DIAGRAM 9

ASSEMBLY A20

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C38	B4	C1	CR67	C4	C2	Q13	B5	B1	Q68	B4	C2
C42	B5	A1				Q16	B4	B1			
C78	B4	C2	P15	A4	B1	Q17	A4	C1	R24	A5	B1
			P45	B5	B2	Q43	A5	B2	R26	A4	B1
CR35	B4	B1	P47	C4	C2	Q46	A4	B2	R34	B5	B1
CR53	C4	B2				Q50	B4	A2	R36	B4	B1
CR65	B4	B2	Q12	A5	A1	Q58	B4	C2	R37	A4	C1

ASSEMBLY A21

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
F1	A3	C2	F2A	A3	D1	F2B	A3	D1	F2C	A3	D1

ASSEMBLY A22

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS22	B5	A1	S22	C5	A1			

ASSEMBLY A33

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J3600	E1	A4

Partial A33 also shown on diagrams 1, 2,

ASSEMBLY A35

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS3798	D5	A3	P3798	D5	B1			

Partial A35 also shown on diagrams 5, 6 and 8.

ASSEMBLY A39

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P4377	C3	B1

Partial A39 also shown on diagrams 5 an

ASSEMBLY A38

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C4260	D1	G2	C4397	G5	G7	P4110	C3	J2	R4264	E1	G1
C4267	D2	F2				P4111	D1	G1	R4266	F2	H2
C4275	F1	F1	CR4260	D3	H2	P4117	C4	J2	R4273	F1	G2
C4276	F1	G2	CR4282	F2	H3	P4118	F1	G1	R4274	F1	G2
C4306	C5	E5	CR4304	C4	F7	P4119	E1	F1	R4276	F2	G2
C4316	D4	E5	CR4325	E4	F7	P4174	E5	D7	R4278	F1	G2
C4317	D5	F5	CR4346	F4	G2	P4179	C3	G7	R4280	F1	G1
C4324	C4	G6	CR4350	E5	F5	P4181	D1	H7	R4281	F1	G2
C4328	E4	F6	CR4367	F5	F6	P4198	D5	G7	R4282	F1	H3
C4332	E3	F6	CR4368	F5	E7				R4283	F2	H2
C4334	F3	F5	CR4371	G4	H6	Q4139	F1	H2	R4301	C4	G1
C4343	F3	G4	CR4372	G4	H6	Q4147	F2	G2	R4303	C3	F6
C4345	F3	G2	CR4375	G4	G6	Q4149	F1	H2	R4305	C4	E6
C4347	E4	F2	CR4376	G4	G6	Q4158	F2	H3	R4306	C5	E6
C4350	E5	E5	CR4379	G4	G5	Q4159	F3	J4	R4308	D5	E6
C4358	F5	G6	CR4380	G4	G5	Q4174	F5	F5	R4309	D4	E6
C4368	F5	F7	CR4385	G5	G5	Q4175	F5	F5	R4310	D4	E6
C4369	F5	G6	CR4386	G5	G5	Q4176	F5	F5	R4312	D4	E5
C4373	G4	G5	CR4386	G5	G5	Q4177	F3	G5	R4313	D4	E5
C4377	G4	H7	CR4391	G5	G6	Q4179	F3	G5	R4315	D5	F6
C4381	G4	H7	CR4392	G5	G6	Q4184	D4	E6	R4316	D5	F6
C4382	G4	H6	CR4395	G5	G6	Q4185	D4	E6	R4317	D5	F5
C4383	H4	J6	CR4396	G5	G6	Q4186	E4	E7	R4319	D4	E5
C4387	G5	H6				Q4189	F4	G5	R4320	D4	G6
C4388	G5	H6	F4301	D3	J1				R4321	D4	E5
C4389	H5	J6				R4260	E1	G1	R4322	D4	D3
C4393	G5	H7	K4260	E2	H1	R4261	D1	H7	R4323	D4	G7

Partial A38 also shown on diagrams 1, 2, 3, 4, 5, 6, 7 and 8.

ations.

R EXAMPLE

mber
234
Schematic Circuit Number

on Assembly Number
ctrical Parts List.

Devices
jection

POWER SUPPLY AND CRT DIAGRAM 9

ASSEMBLY A20

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C38	B4	C1	CR67	C4	C2	Q13	B5	B1	Q68	B4	C2	R42	A5	A1	R67	C4	C2
C42	B5	A1				Q16	B4	B1				R51	A5	A2	R70	B4	A2
C78	B4	C2	P15	A4	B1	Q17	A4	C1	R24	A5	B1	R59	A4	C2	R73	B4	B2
			P45	B5	B2	Q43	A5	B2	R26	A4	B1	R60	B4	A2	R83	B4	B2
CR35	B4	B1	P47	C4	C2	Q46	A4	B2	R34	B5	B1	R63	C4	B2	R87	B4	C2
CR53	C4	B2				Q50	B4	A2	R36	B4	B1	R64	B5	B2			
CR65	B4	B2	Q12	A5	A1	Q58	B4	C2	R37	A4	C1	R65	B5	B2			

ASSEMBLY A21

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
F1	A3	C2	F2A	A3	D1	F2B	A3	D1	F2C	A3	D1	F3	A3	B1			

ASSEMBLY A22

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS22	B5	A1	S22	C5	A1			

ASSEMBLY A33

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J3600	E1	A4	J3600	E5	A4	P2400	E5	C1

Partial A33 also shown on diagrams 1, 2, 3, 4, 5 and 6.

ASSEMBLY A35

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS3798	D5	A3	P3798	D5	B1			

Partial A35 also shown on diagrams 5, 6 and 8.

ASSEMBLY A39

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P4377	C3	B1	S4350	B3	E2			

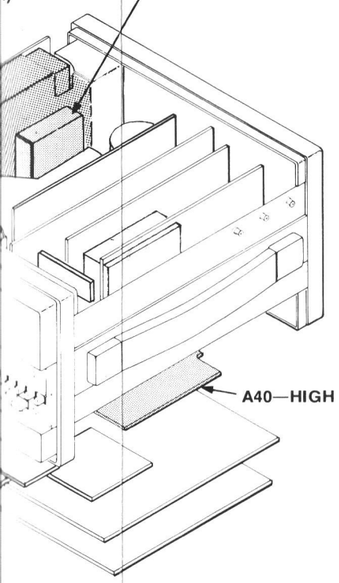
Partial A39 also shown on diagrams 5 and 8.

ASSEMBLY A38

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C4260	D1	G2	C4397	G5	G7	P4110	C3	J2	R4264	E1	G1	R4325	E4	E7	R4375	G4	G6
C4267	D2	F2				P4111	D1	G1	R4266	F2	H2	R4327	E3	F7	R4377	G4	G3
C4275	F1	F1	CR4260	D3	H2	P4117	C4	J2	R4273	F1	G2	R4329	E4	F6	R4392	G5	G6
C4276	F1	G2	CR4282	F2	H3	P4118	F1	G1	R4274	F1	G2	R4330	E4	F6	R4397	G5	G7
C4306	C5	E5	CR4304	C4	F7	P4119	E1	F1	R4276	F2	G2	R4332	E3	G6			
C4316	D4	E5	CR4325	E4	F7	P4174	E5	D7	R4278	F1	G2	R4334	F3	G5	T4300	G2	H5
C4317	D5	F5	CR4346	F4	G2	P4179	C3	G7	R4280	F1	G1	R4336	F3	G5			
C4324	C4	G6	CR4350	E5	F5	P4181	D1	H7	R4281	F1	G2	R4338	F3	G5	TP4165	D4	F5
C4328	E4	F6	CR4367	F5	F6	P4198	D5	G7	R4282	F1	H3	R4339	F3	G6	TP4186	E4	G6
C4332	E3	F6	CR4368	F5	E7				R4283	F2	H2	R4341	F3	G5	TP4377	H4	H7
C4334	F3	F5	CR4371	G4	H6	Q4139	F1	H2	R4301	C4	G1	R4343	F3	G5	TP4383	H4	H7
C4343	F3	G4	CR4372	G4	H6	Q4147	F2	G2	R4303	C3	F6	R4344	F3	H2	TP4384	G4	H7
C4345	F3	G2	CR4375	G4	G6	Q4149	F1	H2	R4305	C4	E6	R4345	E3	H2	TP4389	H5	H7
C4347	E4	F2	CR4376	G4	G6	Q4158	F2	H3	R4306	C5	E6	R4346	E4	F2	TP4393	H5	J7
C4350	E5	E5	CR4379	G4	G5	Q4159	F3	J4	R4308	D5	E6	R4347	E4	F2			
C4358	F5	G6	CR4380	G4	G5	Q4174	F5	F5	R4309	D4	E6	R4348	E4	F2	U4126	F4	G2
C4368	F5	F7	CR4385	G5	G5	Q4175	F5	F5	R4310	D4	E6	R4350	E5	F5	U4155	D5	F5
C4369	F5	G6	CR4386	G5	G5	Q4176	F5	F5	R4312	D4	E5	R4351	E5	G6	U4156A	D4	F5
C4373	G4	G5	CR4386	G5	G5	Q4177	F3	G5	R4313	D4	E5	R4353	E5	G6	U4156B	C5	F5
C4377	G4	H7	CR4391	G5	G6	Q4179	F3	G5	R4315	D5	F6	R4355	E5	F5	U4156C	D4	F5
C4381	G4	H7	CR4392	G5	G6	Q4184	D4	E6	R4316	D5	F6	R4357	F5	G6	U4156D	F5	F5
C4382	G4	H6	CR4395	G5	G6	Q4185	D4	E6	R4317	D5	F5	R4360	F5	G7	U4165	D4	E7
C4383	H4	J6	CR4396	G5	G6	Q4186	E4	E7	R4319	D4	E5	R4365	E5	F6			
C4387	G5	H6				Q4189	F4	G5	R4320	D4	G6	R4366	E5	F6	VR4282	F2	H2
C4388	G5	H6	F4301	D3	J1				R4321	D4	E5	R4368	F5	F7	VR4332	E3	G6
C4389	H5	J6				R4260	E1	G1	R4322	D4	D3	R4369	F5	F6			
C4393	G5	H7	K4260	E2	H1	R4261	D1	H7	R4323	D4	G7	R4373	G4	G6			

Partial A38 also shown on diagrams 1, 2, 3, 4, 5, 6, 7 and 8.

A20—BATTERY CONDITIONER BD (UNDER COVER)



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POWER SUPPLY AND CRT DIAGRAM 9

ASSEMBLY A40

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C4421	H1	C2
C4422	H1	C2
C4423	H1	D1
C4424	H1	D2
C4425	H1	D2
C4426	H1	D3
C4446	H2	A2
C4461	H4	B1
C4463	H4	B2
CR4421	H1	C2
CR4422	H1	C2
CR4423	H1	D2
CR4424	H1	D2
CR4425	H1	D2
CR4426	H1	D2
CR4443	H2	A2
CR4445	H2	B2
CR4446	H2	B2
CR4451	H3	B2
CR4452	H3	B2
CR4453	H3	B2
CR4454	H3	B2
CR4455	H3	B1
CR4456	H3	B2
CR4461	H4	C1
CR4463	H4	B3
P4441	H2	A1
P4450	H3	B2
P4471	H4	B3
Q4442	H2	B1
Q4446	H2	A1
R4421	H1	C2
R4431	H1	D1
R4432	H1	D1
R4433	H1	D1
R4434	H1	D1
R4437	H1	D3
R4440	H2	B1
R4442	H2	A2
R4443	H2	A2
R4444	H2	A2
R4454	H3	B2
R4455	H3	B2
R4456	H3	B2
R4461	H4	C2
R4463	H4	B3

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
CR5423	D1	CHASSIS
CR5424	D2	CHASSIS
DS5420	D1	CHASSIS
F5421	C1	CHASSIS
F5422	B2	CHASSIS
J10	A3	CHASSIS
J5420	C1	CHASSIS
J5425	D2	CHASSIS
S5420	D1	CHASSIS
T5420	D1	CHASSIS
V5440	G1	CHASSIS

A B C D E F G H

1 2 3 4 5

VOLTAGE & WAVEFORM CONDITIONS
SEE APRON OF 8

(EUROPEAN VERSION)

LINE VOLTAGE RANGE S5420 — 115V / 230V / 230V / 115V

AC LINE VOLTAGE INPUT

MAINS CONNECTED — DS5420 (GRN)

OPTIONAL TRICKLE CHARGE

PARTIAL A33 CONDITIONER BOARD — ΔT FROM U3607-6

OPTIONAL (TO DRM)

BATTERY CHARGER

+8V UNREG

MOUNTING SCREW — GND J5425

POWER TO OPTIONAL RECORDER — J10

A21 BATTERY BOARD

BT1 (4-NiCD CELLS)

PARTIAL A39 SWEEP SWITCH BD

S4350 — ON / OFF — MONITOR

+7V

+2.5V REFERENCE AND +5V REGULATOR

F4301 5A

U4165 2.5V REF — TP4165 +2.5V — +2.5V REF

U4156C ¼ 324 — U4156B ¼ 324 — U4156A ¼ 324

Q4186 — Q4185 — Q4184 — Q4175 — Q4177

BATTERY STATUS

LOW BATTERY SHUTDOWN

OVERVOLTAGE SHUTDOWN — U4126 MC5423

Q4189

CONVERTER REGULATOR — Q4176 — Q4174

Q4158 — T4300 — Q4159

POWER SUPPLY CONVERTER

≈ 30kHz — 0.6VAC, 400mA RMS

V5440 — +3400V

FOCUS — +175V — Q4442 — Q4446 — -7V — -12V

CRT BIAS & BLANKING

CHOP BLANK FROM U4132A-3

RETRACE BLANK FROM U4124B-10

P/P & RESP OFF FROM U4122B-4

ECG OFF FROM U4122C-10

DIAG 8

J4450 FOR TEST ONLY INSTALL SHORTING JUMPER TO DIM CRT

+7V

A40 HIGH VOLTAGE BOARD

TO B/B RATE CONVERTER BOARD (OPTIONAL)

NOTE
* 1%, T-9 RESISTOR
** 0.1%, T-9 RESISTOR
✓ READS APPROX 3300V WHEN MEASURED WITH 20kΩ/V VOM

COMPONENT NUMBER EXAMPLE
Component Number: A23 A2 R1234
Assembly Number – Subassembly Number (if used) – Schematic Circuit Number

Chassis mounted components have no Assembly Number prefix – see end of Replaceable Electrical Parts List

Static Sensitive Devices
See Maintenance Section

26V P-P TO P3900-6-7 DIAG 7

PARTIAL A36 MAIN BD

BATT CHG DISABLE — DISCHARGE CIRCUITS — Q17 Q16 Q46 Q12 Q13 Q43 Q5B Q50 Q6B

A20 BATTERY CONDITIONER BD

DS22 — S22 START — A22 START SW. BD — START CIRCUIT

BATTERY PACK

OK/CHG (GRN) LOW (RED) BATTERY DS3798

SEE DIAG 6 8

PARTIAL A35 READOUT SWITCH BOARD

PARTIAL A33 CONDITIONER BOARD — P2400 OPTIONAL (TO RECORDER) — LO BATT / MONITOR ON

FOR TEST ONLY INSTALL SHORTING JUMPER TO ACTIVATE LOW-BATT SHUTDOWN

2894-89 REV A FEB 1981

413A

POWER SUPPLY AND CRT 9

Monitor plugged in.
Unit off.
Cycle during routine maintenance.
Cycle during discharge
If these monitors
cycle will be off this chk.
- Next 12 - how but this cycle check

ECG BOARD (P3000) PIN ASSIGNMENTS

	DESCRIPTION	TO/FROM
1	Ground #2	
2	-12 V	
3	-7 V	
4	+7 V	
5	+12 V	
6	NC	
7	NC	
8	NC	
9	NC	
10	NC	
11	NC	
12	NC	
13	NC	
14	NC	
15	NC	
16	Lead Fault	CR4178
17	ECG Off	P3400-20, P3200-24, U4122F-14
18	ECG SIZE (CCW)	P4172-1
19	ECG SIZE (Wiper)	P4172-3
20	ECG SIZE (CW)	P4172-2
21	QRS Disable	Not used
22	Press/Pulse & Resp Display Off	P3400-19
23	ECG Trig	P3200-22, U4133C-8
24	200 kHz	U4142-11
25	NC	
26	NC	
27	+5 V	
28	ECG Wave (0.25 V/Cm)	U4133B-4
29	-ECG Wave	J3600-49, P2400-24
30	ECG Output (×1000)	P4113-1

RESPIRATION P3200 PIN ASSIGNMENTS

	DESCRIPTION	TO/FROM
1	Ground #2	
2	-12 V	
3	-7 V	
4	+7 V	
5	+12 V	
6	NC	
7	NC	
8	NC	
9	NC	
10	Missing QRS	
11	NC	
12	NC	
13	NC	
14	NC	
15	NC	
16	Lead Fault	CR4117
17	Resp Trace Off	P3400-21
18	Resp SIZE R5320 (CCW)	P4193-3
19	Resp SIZE R5320 (Wiper)	P4193-4
20	Resp SIZE R5320 (CW)	P4193-5
21	Resp Off	J3600-15
22	ECG Trig	U4133C-8
23	Resp Trig	J3600-50, CR4176
24	ECG Off	P3000-17, P3400-20
25	Pulse/Press	P3400-18, J3600-53,U3633A-3
26	Press/Pulse Trace Off	P3400-23
27	+5 V	
28	Resp Wave (0.25 V/cm)	P3400-30
29	Resp Output (0.5 V/cm)	J3600-21,P4113-6
30	50 kHz	U4142B-13

PRESSURE/PULSE BOARD P3400 PIN ASSIGNMENTS

	DESCRIPTION	TO/FROM
1	Ground #2	
2	-12 V	
3	-7 V	
4	+7 V	
5	+12 V	
6	Pulse SIZE R5350 (CCW)	P4174-3
7	Pulse SIZE R5350 (Wiper)	P4174-2
8	Pulse SIZE R5350 (CW)	P4174-1
9	Pressure ZERO R5344 (CCW)	P4194-3
10	Pressure ZERO R5344 (Fine Wiper)	P4194-6
11	Pressure ZERO R5344 (CW)	P4194-5
12	Press/Pulse Trigger	U4133D-11, J3600-51, P2400-28, U3619C-12
13	Chop Blank	U4132C-8
14	Chop Clock (2 kHz)	J3600-19, U3613-3
15	Ground #2	
16	Skip A/V	J3600-22, U3620B-5, J5300A-3
17	+7 V	J3600-37, U3649F-14
18	Pulse/Press	J3600-53, P3200-25, U3633A-3
19	Press/Pulse & Resp Trace Off	P3000-22, U4122A-3
20	ECG Off	P300-17
21	Resp Off/Resp Trace Off	P3200-17
22	Press/Pulse/Resp Wave	U4133A-1
23	Press/Pulse Trace Off	P3200-26
24	Pressure ZERO R5344 (Coarse Wiper)	P4194-4
25	Ground #2	J3600-38, P2400-2
26	+7 V	J3600-25, U3620B-3, P2400-4
27	+5 V	
28	A/V Wave Scaled	J3600-26, U3613-5, P2400-23
29	A/V Wave/ Pulse Wave	P4113-5, J3600-56, P2400-8
30	Resp Wave (0.25 V/cm)	P3200-28
41	Dual Pressure	Not Used in 413A
42	Dual Pressure	Not Used in 413A
43	Dual Pressure	Not Used in 413A
44	Dual Pressure	Not Used in 413A

CONDITIONER BOARD J3600 PIN ASSIGNMENTS

	DESCRIPTION	TO/FROM
1	ALARM	P4190-1, P3790-1, U3630C-7
2	PRESSURE/PULSE ALARM Switch	S3730
3	Readout Switch	P4195, P3795-5, S3820
4	Readout Switch	P4195-2, P3795-2, S3820
5	Readout Switch	P4195-3, P3795-3, S3820
6	Readout Switch	P4195-4, P3795-4, S3820
7	Readout Switch (TA Sel)	P4195-5, P3795-5, S3820
8	Readout Switch (TB Sel)	P4195-6, P3795-6, S3820
9	ALARM RESET	P3798-5, P4198-5, S3780
10	ZERO READOUT PUSH Switch	P4194-1, S5344
11	HEART HIGH RATE LIMITS R.O. PUSH	P4196-2, P3896-2, S3745
12	HEART LOW RATE LIMITS R.O. PUSH	P4196-6, P3896-6, S3749
13	RESP HIGH RATE LIMITS R.O. PUSH	P4196-7, P3896-7, S3753
14	RESP LOW RATE LIMITS R.O. PUSH	P4196-8, P3896-8, S3757
15	RESP CHANNEL OFF Switch	P4193-7, S5320
16	Selected Trig	U4124A-6
17	Alarm Out	P4113-4, J5414 (RING)
18	Low ECG Rate	U3278D-11
19	A Wave Scaled	P3400-15
20	mm /m Display Units	P4192, P2356, DS4050, DS4060
21	Resp Wave (0.5 V/cm)	P3400-166, U3455C-6
22	Skip A/V	P3400-16, U3455C-6
23	Resp Effort ARREST ALARM Switch	P4172-2, P4379-2, S3740
24	Resp Effort DELAY Switch	P4172-1, P4379-2, S3750
25	Skip A	P3400-26 (+7 V)
26	A/V Wave Sclaed	P3400-28
27	Sample (DVM)	P3900-10, Q3971
28	Update (DVM)	P3900-22, Q3852
29	DP2	P3900-26
30	+2.5 V Reference	
31	Ground #2	
32	-12 V	
33	-7 V	
34	+7 V	
35	+12	
36	Dual Pressure	P4175-1
37	+7 V	P3400-17
38	A Wave/Pulse Wave	P3400-25 (Gnd #2)
39	HEART HIGH RATE LIMIT (R3745, Wiper)	P3896-1, P4196-1
40	HEART LOW RATE LIMIT (R3749, Wiper)	P3896-4, P4196-4
41	HEART RATE ALARM OFF (S3748)	P3896-3, P4196-3
42	RESP HIGH RATE LIMIT (R3753 (Wiper)	P3896-5, P4196-5
43	RESP LOW RATE LIMIT (R3757 (Wiper)	P3896-9, p4196-9
44	RESP RATE ALARM OFF (S3756)	P3896-10, P4196-10
45	Audio (Alarm)	P4115-3, CR3786
46	Low Battery/Monitor On	U4155-3, P2400-13
47	Alarm Reset	P4113-3, J5414 (TIP)
48	Ground #1	
49	-ECG Wave	P3000-29, P2400-24
50	Resp Trig	P3200-23
51	Press/Pulse Trig	P3400-12, U3455B-4
52	ΔT Signal	P4118-3
53	Pulse/Pressure	P3400-18, S3400B
54	°C/°F	P4192-10, P2356-10, DS4070, DS4080
56	A/V Wave/Pulse Wave	P3400-29, S3400B
57	Sign Enable	P3900-21, U3634A-3
58	Blanking	P3900-23, U3632-3
59	DVM In	P3900-28, U3653A-15
60	DVM Com	P3900-29 (Gnd #1)

DV P3900 PI

	DESCRIPTION
1	Ground #2
2	-12 V
3	-7 V
4	+7 V
5	+12 V
6	26 V p-p ≈30 kHz
7	26 V p-p ≈30 kHz
8	NC
9	NC
10	Sample (DVM)
11	-Sign
12	+sign
13	1 (half digit)
14	g
15	f
16	e
17	d
18	c
19	b
20	a
21	Sign Enable
22	Update (DVM)
23	Blanking
24	NC
25	NC
26	DP2
27	Ground #1
28	DVM In
29	DVM Com
30	+2.5 V Reference
31	NC
32	NC
33	NC
34	NC
35	NC
36	NC
37	NC
38	NC
39	NC
40	NC
41	KA1
42	KA2
43	DEC2
44	NC
45	NC
46	A4
47	A3
48	A2
49	A1
50	NC

Fig. 8-19. Board pin assignments.

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PRESSURE/PULSE BOARD P3400 PIN ASSIGNMENTS

		TO/FROM
		P4174-3
		P4174-2
		P4174-1
		P4194-3
Wiper)		P4194-6
		P4194-5
		U4133D-11, J3600-51, P2400-28, U3619C-12
		U4132C-8
		J3600-19, U3613-3
		J3600-22, U3620B-5, J5300A-3
		J3600-37, U3649F-14
		J3600-53, P3200-25, U3633A-3
		P3000-22, U4122A-3
		P300-17
		P3200-17
		U4133A-1
		P3200-26
Wiper)		P4194-4
		J3600-38, P2400-2
		J3600-25, U3620B-3, P2400-4
		J3600-26, U3613-5, P2400-23
		P4113-5, J3600-56, P2400-8
		P3200-28
		Not Used in 413A
		Not Used in 413A
		Not Used in 413A
		Not Used in 413A

CONDITIONER BOARD J3600 PIN ASSIGNMENTS

	DESCRIPTION	TO/FROM
1	ALARM	P4190-1, P3790-1, U3630C-7
2	PRESSURE/PULSE ALARM Switch	S3730
3	Readout Switch	P4195, P3795-5, S3820
4	Readout Switch	P4195-2, P3795-2, S3820
5	Readout Switch	P4195-3, P3795-3, S3820
6	Readout Switch	P4195-4, P3795-4, S3820
7	Readout Switch (TA Sel)	P4195-5, P3795-5, S3820
8	Readout Switch (TB Sel)	P4195-6, P3795-6, S3820
9	ALARM RESET	P3798-5, P4198-5, S3780
10	ZERO READOUT PUSH Switch	P4194-1, S5344
11	HEART HIGH RATE LIMITS R.O. PUSH	P4196-2, P3896-2, S3745
12	HEART LOW RATE LIMITS R.O. PUSH	P4196-6, P3896-6, S3749
13	RESP HIGH RATE LIMITS R.O. PUSH	P4196-7, P3896-7, S3753
14	RESP LOW RATE LIMITS R.O. PUSH	P4196-8, P3896-8, S3757
15	RESP CHANNEL OFF Switch	P4193-7, S5320
16	Selected Trig	U4124A-6
17	Alarm Out	P4113-4, J5414 (RING)
18	Low ECG Rate	U3278D-11
19	A Wave Scaled	P3400-15
20	mm /m Display Units	P4192, P2356, DS4050, DS4060
21	Resp Wave (0.5 V/cm)	P3400-166, U3455C-6
22	Skip A/V	P3400-16, U3455C-6
23	Resp Effort ARREST ALARM Switch	P4172-2, P4379-2, S3740
24	Resp Effort DELAY Switch	P4172-1, P4379-2, S3750
25	Skip A	P3400-26 (+7 V)
26	A/V Wave Sclaed	P3400-28
27	Sample (DVM)	P3900-10, Q3971
28	Update (DVM)	P3900-22, Q3852
29	DP2	P3900-26
30	+2.5 V Reference	
31	Ground #2	
32	−12 V	
33	−7 V	
34	+7 V	
35	+12	
36	Dual Pressure	P4175-1
37	+7 V	P3400-17
38	A Wave/Pulse Wave	P3400-25 (Gnd #2)
39	HEART HIGH RATE LIMIT (R3745, Wiper)	P3896-1, P4196-1
40	HEART LOW RATE LIMIT (R3749, Wiper)	P3896-4, P4196-4
41	HEART RATE ALARM OFF (S3748)	P3896-3, P4196-3
42	RESP HIGH RATE LIMIT (R3753 (Wiper)	P3896-5, P4196-5
43	RESP LOW RATE LIMIT (R3757 (Wiper)	P3896-9, p4196-9
44	RESP RATE ALARM OFF (S3756)	P3896-10, P4196-10
45	Audio (Alarm)	P4115-3, CR3786
46	Low Battery/Monitor On	U4155-3, P2400-13
47	Alarm Reset	P4113-3, J5414 (TIP)
48	Ground #1	
49	-ECG Wave	P3000-29, P2400-24
50	Resp Trig	P3200-23
51	Press/Pulse Trig	P3400-12, U3455B-4
52	ΔT Signal	P4118-3
53	Pulse/Pressure	P3400-18, S3400B
54	°C/°F	P4192-10, P2356-10, DS4070, DS4080
56	A/V Wave/Pulse Wave	P3400-29, S3400B
57	Sign Enable	P3900-21, U3634A-3
58	Blanking	P3900-23, U3632-3
59	DVM In	P3900-28, U3653A-15
60	DVM Com	P3900-29 (Gnd #1)

DVM BOARD P3900 PIN ASSIGNMENTS

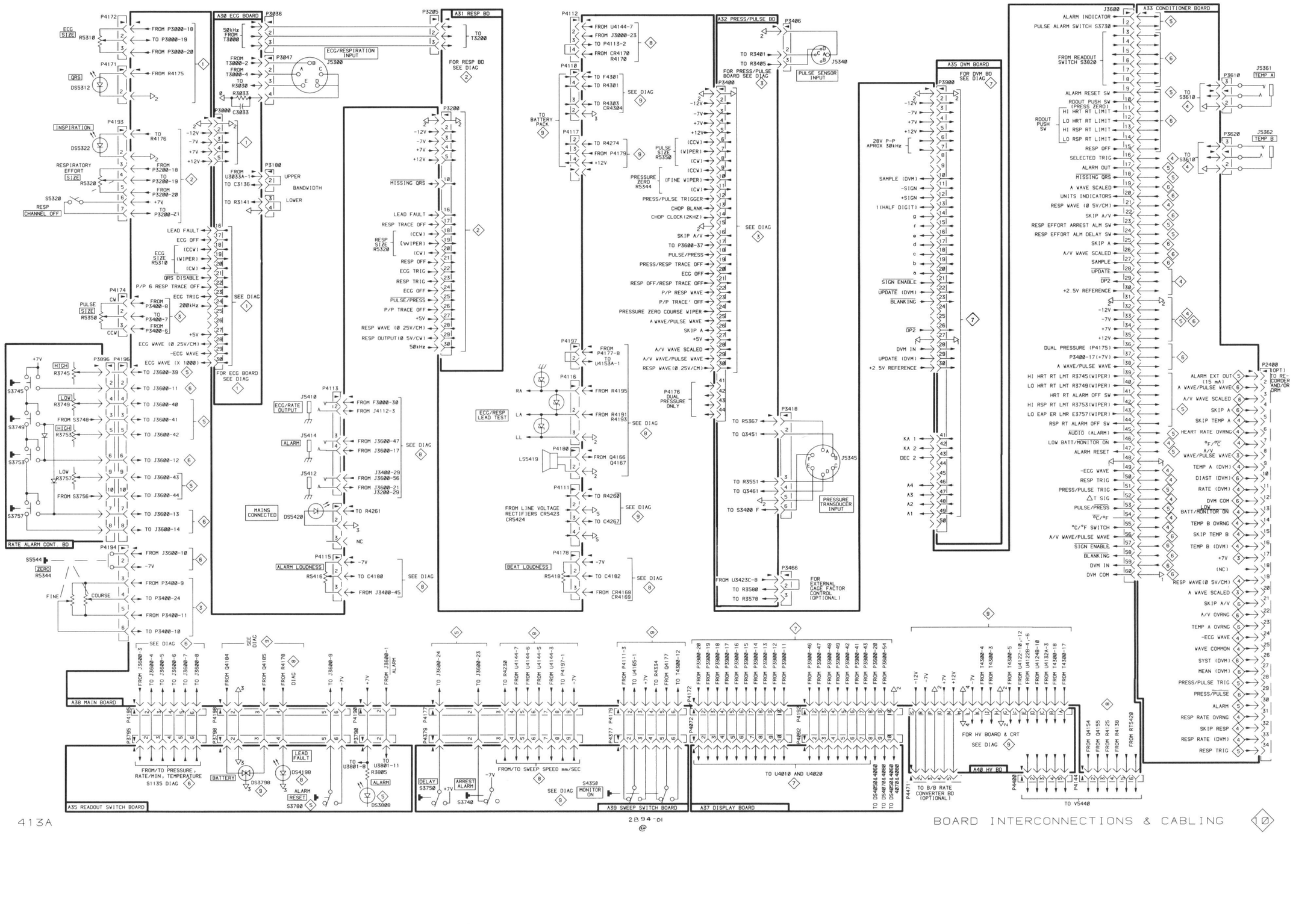
	DESCRIPTION	TO/FROM
1	Ground #2	
2	−12 V	
3	−7 V	
4	+7 V	
5	+12 V	
6	26 V p-p ≈30 kHz	T4300
7	26 V p-p ≈30 kHz	T4300
8	NC	
9	NC	
10	Sample (DVM)	P3600-27, Q3971
11	-Sign	P4173-10
12	+sign	P4173-9
13	1 (half digit)	P4173-8
14	g	P4173-7, U3974-14
15	f	P4173-6, U3974-15
16	e	P4173-5, U3974-9
17	d	P4173-4, U3974-10
18	c	P4173-3, U3974-11
19	b	P4173-2, U3974-12
20	a	P4173-1, U3974-13
21	Sign Enable	J3600-57, U3634A-3
22	Update (DVM)	J3600-28, Q3852
23	Blanking	J3600-58, U3632-3
24	NC	
25	NC	
26	DP2	J3600-29, U3649C-5
27	Ground #1	
28	DVM In	J3600-59, U3653A-15
29	DVM Com	J3600-60 (Gnd #1)
30	+2.5 V Reference	
31	NC	
32	NC	
33	NC	
34	NC	
35	NC	
36	NC	
37	NC	
38	NC	
39	NC	
40	NC	
41	KA1	P4192-6
42	KA2	P4192-5
43	DEC2	P4192-7
44	NC	
45	NC	
46	A4	P4192-1, Q3918
47	A3	P4192-2, Q3908
48	A2	P4192-3, Q3917
49	A1	P4192-4, Q3907
50	NC	

P2400 PIN ASSIGNMENTS

	DESCRIPTION	TO/FROM
1	Alarm Ext out (15 mA)	J3600-17
2	A Wave/Pulse Wave	J3600-38, P3400-25 (Gnd #2)
3	A/V Wave Scaled	J3600-26, P3400-28, U3424C-8
4	Skip A	J3600-25, P3400-26 (+7 V)
5	Skip Temp A	U3621C-8,
6	Heart Rate Overrange	U3616A-6, J3600-55
7	°F/°C	S5364 via CR3658, R3658
8	A/V Wave/Pulse Wave	J3600-56, P3400-29, S3400B
9	Temp A (DVM, 10 mV/deg)	U3611D-14
10	Diast (DVM, 10 mV/mmHg)	U3647B-7
11	Rate (DVM, 10 mA/bpm)	U3614B-7
12	DVM Common	J3600-48 (Gnd #1)
13	Low Batt/Monitor On	J3600-46, U4155-6
14	Temp B Overrange	U3623C-6
15	Skip Temp B	U3621B-7
16	Temp B (DVM, 10 mV/deg)	U3611C-8
17	+7 V	J3600-34
18	NC	
19	Resp Wave (0.5V/cm)	J3600-21, P3200-29, U3241A-1
20	A Wave Scaled	J3600-19, P340015 (Gnd #2)
21	Skip A/V	J3600-22, P3400-16, U3466C-6
22	A/V Overrange	U3623A-2
23	Temp A Overrange	U3623B-4
24	-ECG Wave	J3600-49, P3000-29, U3071C-8
25	Wave Common	J3600-31 (Gnd #2)
26	Syst (DVM, 10 mV/mmHg)	U3647A-1
27	Mean (DVM, 10 mV/mmHg)	U3637A-1
28	Press/Pulse Trig	J3600-51, P3400-12, U3455B-4
29	Press/Pulse	U3633A-2
30	Alarm	U3634D-11
31	Resp Rate Overrange	U3616B-10
32	Skip Resp	J3600-15, P4193-7, S5320
33	Resp Rate (DVM,10 mV/breaths/min	U3614C-8
34	Resp Trig	J3600-50, P3200-23, U3211-3

Fig. 8-19. Board pin assignments.

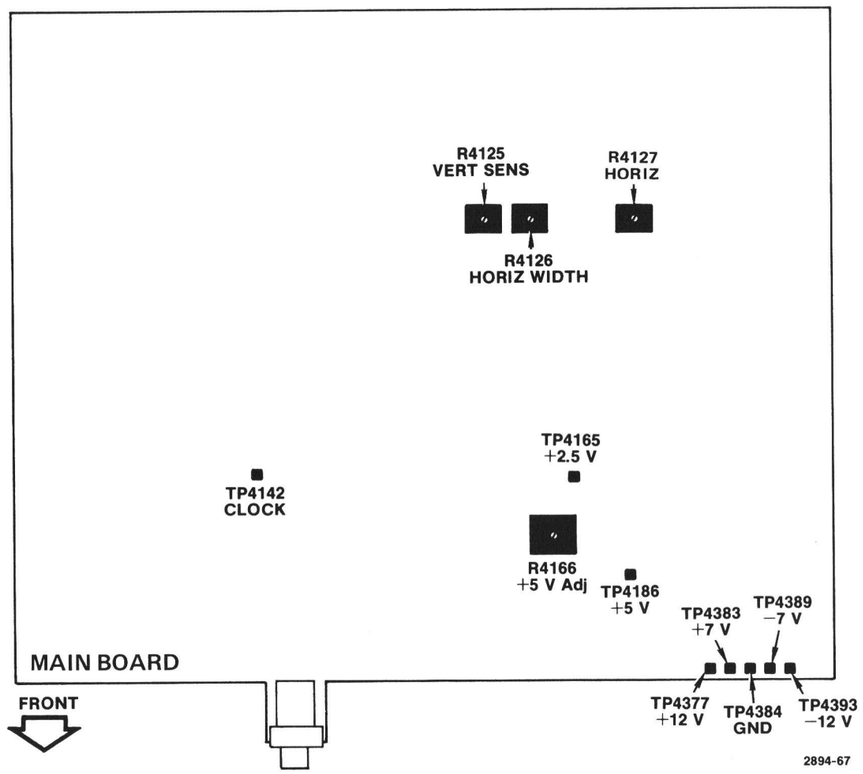
2894-66

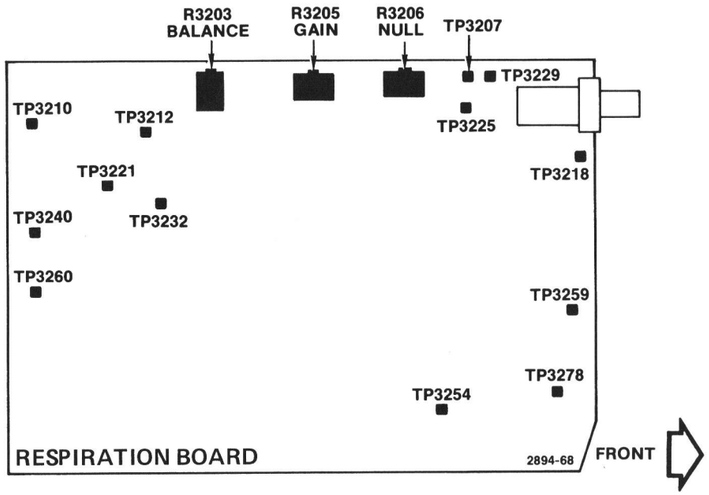


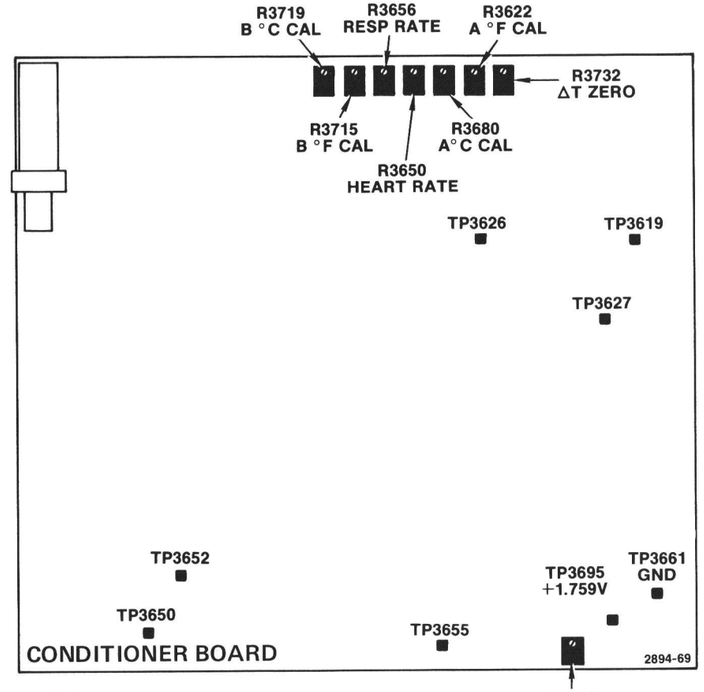
413A

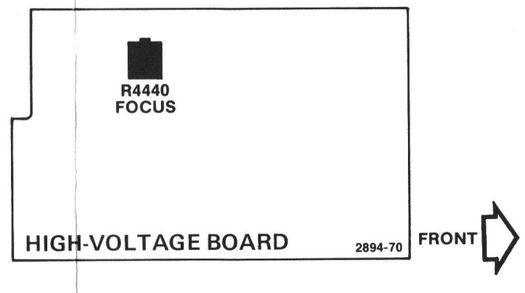
2894-01

BOARD INTERCONNECTIONS & CABLING 10









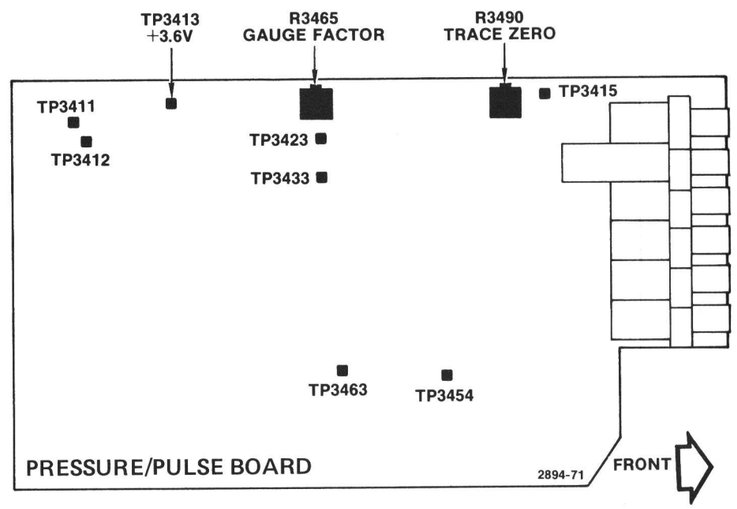


Fig. 8-20. Test point and adjustment locations.

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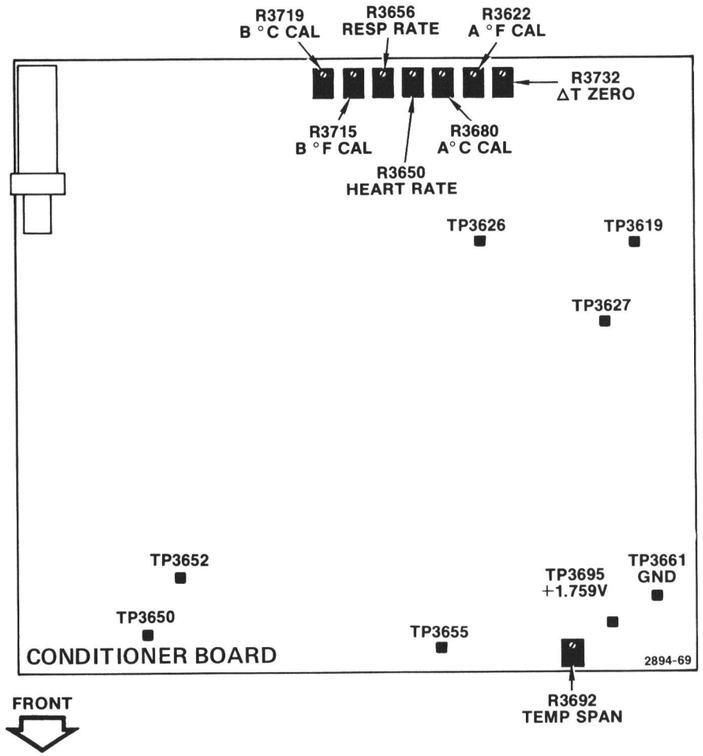
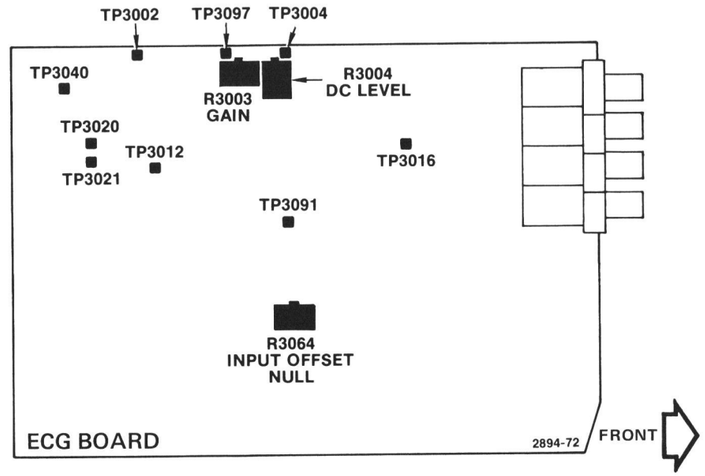
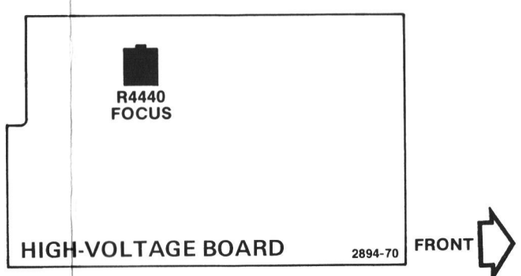
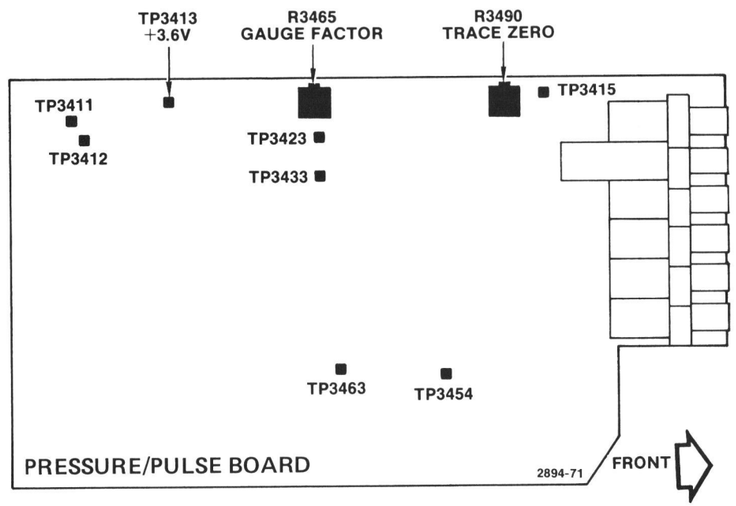








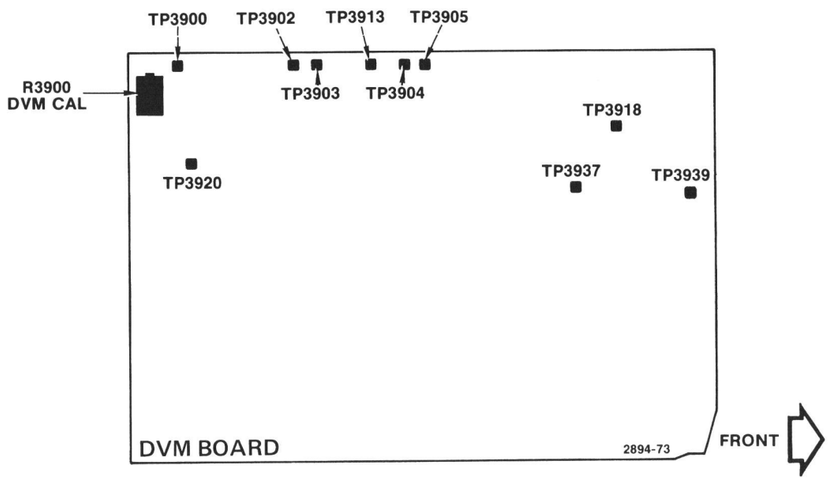


Fig. 8-20. Test point and adjustment locations.

@

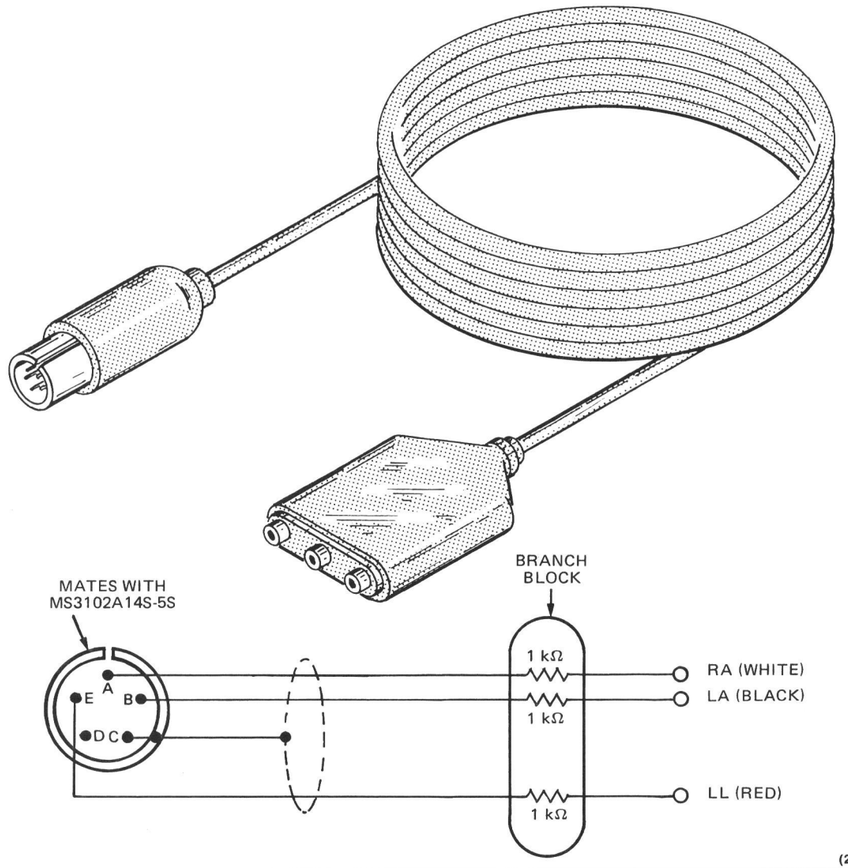


Fig. 8-21. ECG/RESP cable.

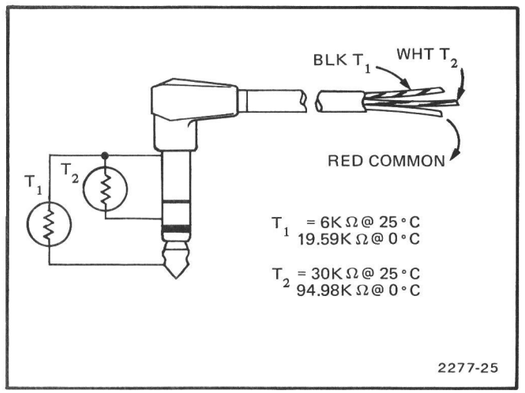


Fig. 8-22. Temperature sensor plug.

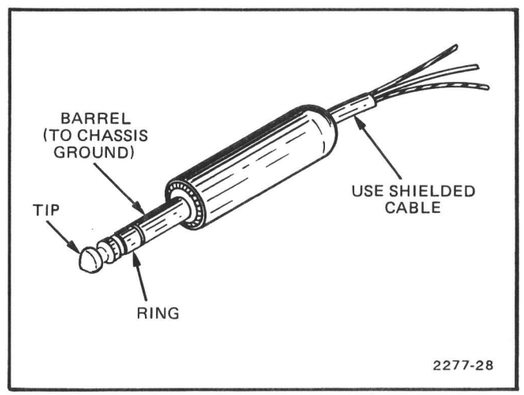
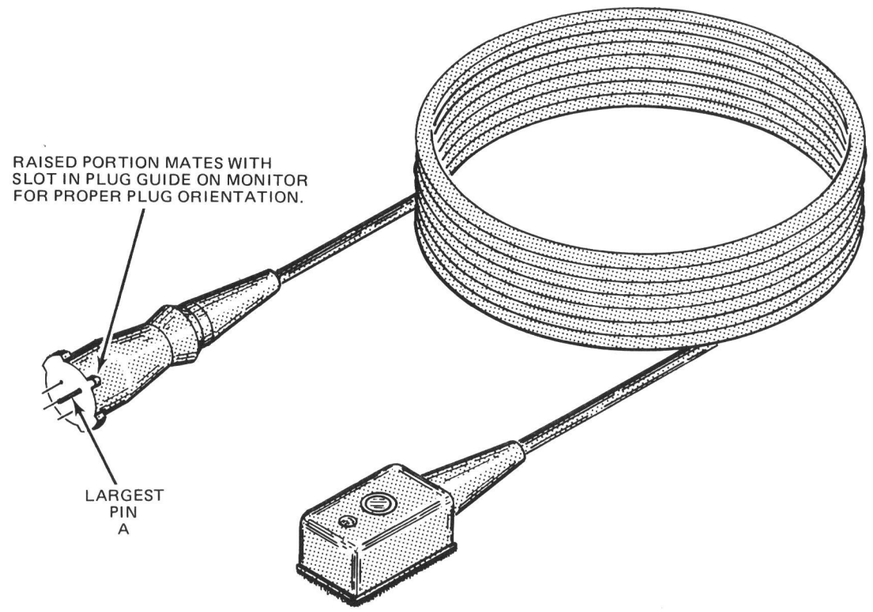
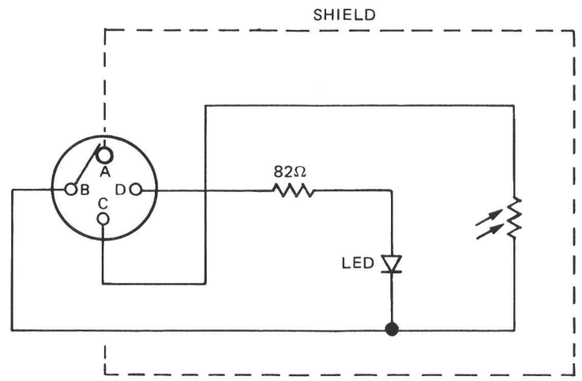


Fig. 8-23. Three-circuit 1/4-inch phone plug used for interconnecting signals at rear panel input/output jacks.



A plug similar to Winchester M4PLSH10C on the pulse sensor cable mates with the Winchester M4SLRN bulkhead connector on the monitor.



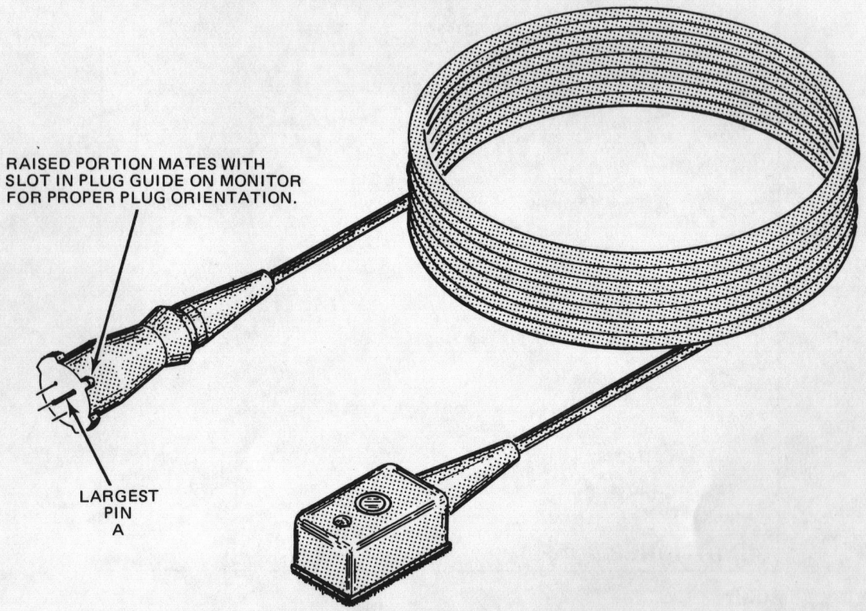
Typical light-emitting diode (LED) with series resistor draws 22 mA at 3.6 V.

2277-26

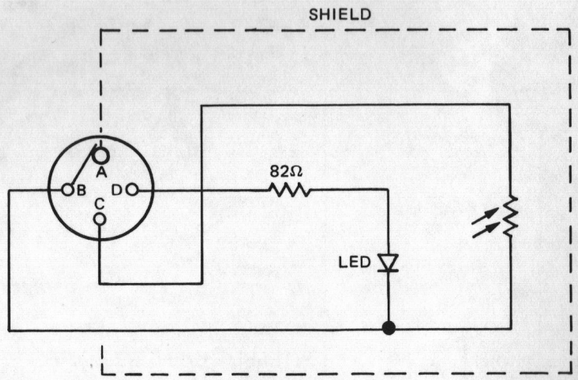
Fig. 8-24. Pulse sensor cable.

@

Plug numb
connector



A plug similar to Winchester M4PLSH10C on the pulse sensor cable mates with the Winchester M4SLRN bulkhead connector on the monitor.

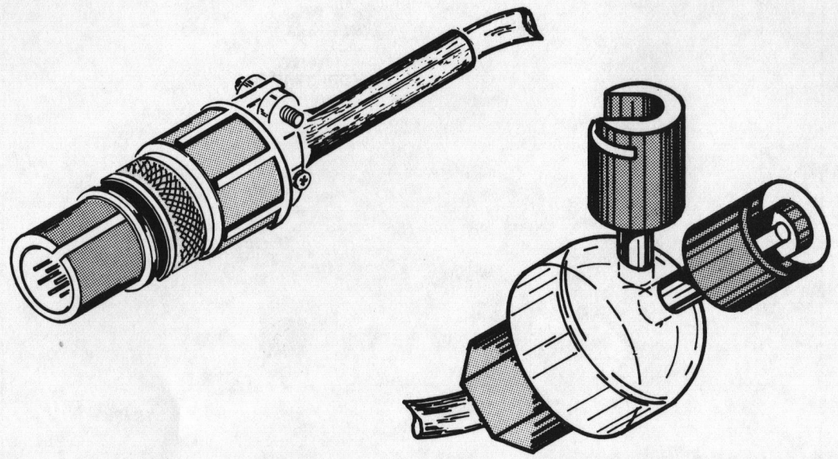


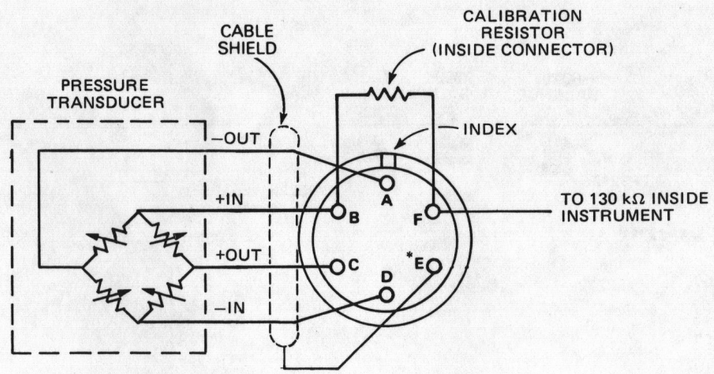
Typical light-emitting diode (LED) with series resistor draws 22 mA at 3.6 V.

2277-26

Fig. 8-24. Pulse sensor cable.

Plug number MS3106A-14S-6P on the pressure transducer cable mates with the MS3102A-14S-6S bulkhead connector on the monitor. The cable clamp number is MS3057-6A and the bushing number is MS3420-6.





* DO NOT CONNECT CONNECTOR SHELL TO THIS PIN.

(2042-18)2277-27

Fig. 8-25. Pressure transducer cable.

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
- - - * - - -
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
- - - * - - -
Parts of Detail Part
Attaching parts for Parts of Detail Part
- - - * - - -

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

"	INCH
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W/	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
S3629	PANEL COMPONENTS CORP.	2015 SECOND ST.	BERKELEY, CA 94170
000CP	AIMSCO	4024 22ND AVE. WEST	SEATTLE, WA 98199
000CY	NORTHWEST FASTENER SALES, INC.	7923 SW CIRRUS DRIVE	BEAVERTON, OR 97005
000EL	PORTLAND SCREW CO.	6520 N. BASIN AVE.	PORTLAND, OR 97217
000FB	CALIFORNIA EASTERN LABORATORIES	3005 DEMOCRACY WAY	SANTA CLARA, CA 95050
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
02929	NEWARK ELECTRONICS CORPORATION	500 N PULASKI ROAD	CHICAGO, IL 60624
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
09922	BURNDY CORPORATION	RICHARDS AVENUE	NORWALK, CT 06852
12136	PHILADELPHIA HANDLE COMPANY, INC.	1643 HADDON AVENUE	CAMDEN, NJ 08103
12360	ALBANY PRODUCTS CO., DIV. OF PNEUMO DYNAMICS CORPORATION	145 WOODWARD AVENUE	SOUTH NORWALK, CT 06586
13103	THERMALLOY COMPANY, INC.	2021 W VALLEY VIEW LANE P O BOX 34829	DALLAS, TX 75234
19209	GENERAL ELECTRIC CO., ELECTRONIC CAPACITOR AND BATTERY PRODUCTS DEPT. BATTERY PRODUCTS SEC.	P. O. BOX 114	GAINESVILLE, FL 32601
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
22670	G.M. NAMEPLATE, INC.	2040 15TH AVENUE WEST	SEATTLE, WA 98119
52905	SIMPLEX MFG. COMPANY	5224 NE 42ND AVENUE	PORTLAND, OREGON 97218
54516	NATIONAL CABLE MOLDING CORPORATION	136 SAN FERNANDO ROAD	LOS ANGELES, CA 90031
59730	THOMAS AND BETTS COMPANY	36 BUTLER ST.	ELIZABETH, NJ 07207
70485	ATLANTIC INDIA RUBBER WORKS, INC.	571 W. POLK ST.	CHICAGO, IL 60607
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
74921	ITEN FIBRE CO.,	4001 BENEFIT AVE., P O BOX 9	ASHTABULA, OH 44004
77132	DOT FASTENER CO., A UNITED-CARR DIV. OF TRW INC.	ROUND HOUSE INDL PK,PO BOX 710	WATERBURY, CT 06720
77250	PHEOLL MANUFACTURING CO., DIVISION OF ALLIED PRODUCTS CORP.	5700 W. ROOSEVELT RD.	CHICAGO, IL 60650
77969	RUBBERCRAFT CORP. OF CALIF., LTD.	1800 W. 220TH ST.	TORRANCE, CA 90507
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
79807	WROUGHT WASHER MFG. CO.	2100 S. O BAY ST.	MILWAUKEE, WI 53207
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
86445	PENN FIBRE AND SPECIALTY CO., INC.	2032 E. WESTMORELAND ST.	PHILADELPHIA, PA 19134
86928	SEASTROM MFG. COMPANY, INC.	701 SONORA AVENUE	GLENDALE, CA 91201
88245	LITTON SYSTEMS, INC., USECO DIV.	13536 SATICOY ST.	VAN NUYS, CA 91409
93907	TEXTRON INC. CAMCAR DIV	600 18TH AVE	ROCKFORD, IL 61101
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641

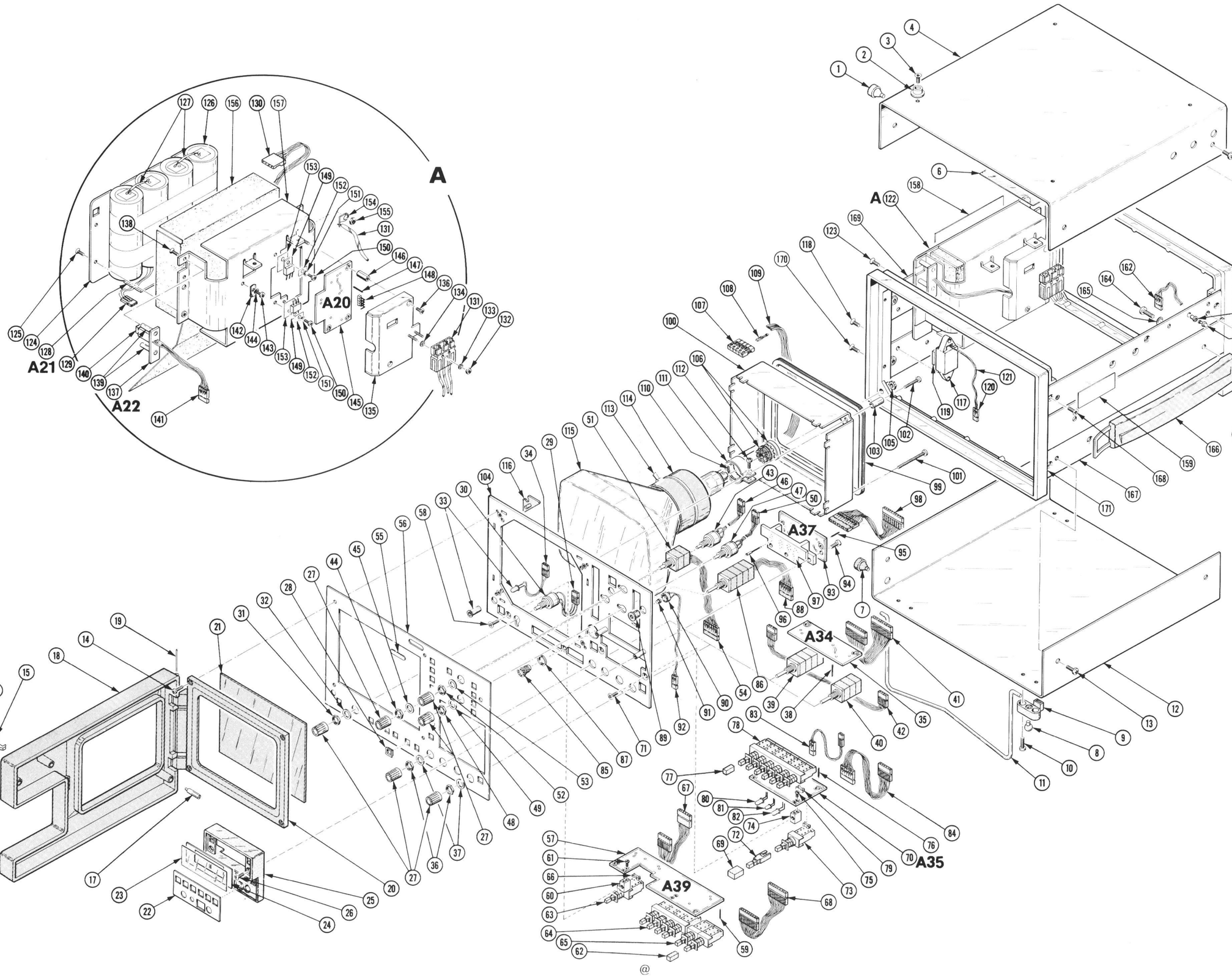
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-1	348-0414-00			2		BUMPER,PLASTIC:0.500 DIA,TEK BLUE	80009	348-0414-00
-2	355-0184-00			4		STUD,SNAP FSTNR:	77132	BS-10370
						(ATTACHING PARTS)		
-3	211-0105-00			4		SCREW,MACHINE:4-40 X 0.188,100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-4	390-0581-01			1		CAB.,WRAPAROUND:TOP	80009	390-0581-01
						(ATTACHING PARTS)		
-5	211-0565-00			4		SCREW,MACHINE:6-32 X 0.250 INCH,TRH STL	83385	OBD
						- - - * - - -		
	----- -----			-		. COVER,TOP INCLUDES:		
-6	342-0212-00			1		. INSULATOR,FILM:CIRCUIT BOARD,MYLAR	80009	342-0212-00
-7	348-0414-00			2		BUMPER,PLASTIC:0.500 DIA,TEK BLUE	80009	348-0414-00
-8	348-0089-00			4		BUMPER,PLASTIC:BLACK VINYL	80009	348-0089-00
-9	348-0380-01			4		FOOT,CABINET:TEK BLUE NYLON	80009	348-0380-01
						(ATTACHING PARTS)		
-10	211-0097-00			8		SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
-11	348-0282-00			1		FLIPSTAND,CAB.:3.438 H,SST	80009	348-0282-00
-12	390-0363-03			1		COVER,MONITOR:BOTTOM	80009	390-0363-03
						(ATTACHING PARTS)		
-13	211-0565-00			4		SCREW,MACHINE:6-32 X 0.250 INCH,TRH STL	83385	OBD
						- - - * - - -		
	200-2136-01			1		DOOR,ACCESS:FRONT,NEONATAL,W/HDW,PLSTC	80009	200-2136-01
						(ATTACHING PARTS)		
-14	211-0646-00			4		SCREW MACHINE:2-56 X 0.375 INCH,PNH,STL	12360	OBD
						- - - * - - -		
	----- -----			-		. DOOR ASSY INCLUDES:		
-15	214-2595-01			1		. LATCH,DOOR:	80009	214-2595-01
-16	214-1530-00			1		. SPRING,HLCPS:0.145 OD X 0.95 L	80009	214-1530-00
-17	214-3016-00			3		. CONDUCTOR,LIGHT:0.725 L X 0.175 OD	80009	214-3016-00
-18	200-2112-04			1		. DOOR,ACCESS:FRONT	80009	200-211204
-19	214-2594-00			2		. PIN,HINGE:	80009	214-2594-00
-20	200-2113-00			1		. RTNR,CRT SCALE:	80009	200-2113-00
-21	337-2405-00			1		SHLD,IMPLOSION:414 MOD 4A	22670	OBD
-22	334-3764-00			1		MARKER,IDENT:MKD W/SWITCH & LIGHT FCTN	80009	334-3764-00
-23	378-0100-00			1		FILTER,LIGHT:AMB,2.4 X 0.85 X 0.03	80009	378-0100-00
-24	331-0433-01			1		MASK,READOUT:	80009	331-0433-01
-25	333-2305-02			1		PANEL,FRONT:	80009	333-2305-02
						(ATTACHING PARTS)		
-26	211-0025-00			2		SCREW,MACHINE:4-40 X 0.375 100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-27	366-1825-01			8		KNOB:GRAY,0.127 ID X 0.392 OD X 0.466 H	80009	366-1825-01
	213-0153-00			8		. SETSCREW:5-40 X 0.125,STL BK OXD,HEX SKT	000CY	OBD
-28	426-1072-00			19		FRAME,PUSH BTN:PLASTIC	80009	426-1072-00
-29	175-3034-00			1		CA ASSY,SP,ELEC:3,26 AWG,3.0 L	80009	175-3034-00
	352-0161-08			1		. CONN BODY,PL,EL:3 WIRE GRAY	80009	352-0161-08
-30	----- -----			1		RES.,VAR,CMPSN:(SEE R5418 REPL)		
						(ATTACHING PARTS)		
-31	210-0583-00			1		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-32	210-0940-00			1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
						- - - * - - -		
-33	----- -----			1		LT EMITTING DIO:(SEE DS5420 REPL)		
-34	352-0161-01			1		. CONN BODY,PL,EL:3 WIRE BROWN	80009	352-0161-01
-35	----- -----			1		CKT BOARD ASSY:RATE ALARM CONTROL(SEE A34 REPL)		
						(ATTACHING PARTS)		
-36	210-0583-00			4		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-37	210-0940-00			4		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
						- - - * - - -		
	----- -----			-		. CKT BOARD ASSY INCLUDgES:		
-38	131-0608-00			14		. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-39	----- -----			2		. RES.,VAR,NONWIR:(SEE A34R3749,R3757 REPL)		
-40	----- -----			2		. RES.,VAR,NONWIR:(SEE A34R3745,R3753 REPL)		
-41	175-3048-00			1		CA ASSY,SP,ELEC:10,26 AWG,3.5 L	80009	175-3048-00
	352-0168-06			2		. CONN BODY,PL,EL:10 WIRE BLUE	80009	352-0168-06

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-42	175-3047-00			1		CA ASSY SP,ELEC:4,26 AWG,6.5 L	80009	175-3047-00
	352-0162-09			2		. CONN BODY,PL,EL:4 WIRE WHITE	80009	352-0162-09
-43	----- -----			1		RES.,VAR,NONWIR:(SEE R5350 REPL)		
						(ATTACHING PARTS)		
-44	210-0583-00			1		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-45	210-0940-00			1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
						- - - * - - -		
-46	175-3055-00			1		CA ASSY,SP,ELEC:3,26 AWG,5.0 L	80009	175-3055-00
	352-0161-04			1		. CONN BODY,PL,EL:3 WIRE YELLOW	80009	352-0161-04
-47	----- -----			1		RES.,VAR,CMPSN:(SEE R5310 REPL)		
						(ATTACHING PARTS)		
-48	210-0583-00			1		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-49	210-0940-00			1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
						- - - * - - -		
-50	175-3057-00			1		CA ASSY,SP,ELEC:3,26 AWG,6.0 L	80009	175-3057-00
	352-0161-02			1		. CONN BODY,PL,EL:3 WIRE RED	80009	352-0161-02
-51	----- -----			1		RES.,VAR,NONWIR:(SEE R5320 REPL)		
						(ATTACHING PARTS)		
-52	210-0583-00			1		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-53	210-0940-00			1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
						- - - * - - -		
-54	175-3053-00			1		CA ASSY,SP,ELEC:7,26 AWG,6.75 L	80009	175-3053-00
	352-0165-03			1		. CONN BODY,PL,EL:7 WIRE ORANGE	80009	352-0165-03
-55	334-1418-00			1		PLATE,INDENT:BLANK	80009	334-1418-00
-56	333-2597-00			1		PANEL,FRONT:	80009	333-2597-00
-57	----- -----			1		CKT BOARD ASSY:SWEEP SWITCH(SEE A39 REPL)		
						(ATTACHING PARTS)		
-58	211-0541-00			2		SCREW,MACHINE:6-32 X 0.25"100 DEG,FLH STL	83385	OBD
						- - - * - - -		
	----- -----			-		. CKT BOARD ASSY INCLUDES:		
-59	131-0608-00			15		. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-60	220-0802-00			2		. NUT BLOCK:0.325 X 0.4 X0.19,(2)0-80 THRU	80009	220-0802-00
						(ATTACHING PARTS)		
-61	211-0186-00			4		. SCREW,MACHINE:0-80 X 0.125,FILH,SST,SLOT	12360	00A008AHBUU01
						- - - * - - -		
-62	366-1559-00			7		. PUSH BUTTON:SIL GY,0.18 SQ X 0.43	80009	366-1559-00
-63	----- -----			1		. SWITCH,PUSH:(SEE A39S4350 REPL)		
-64	----- -----			1		. SWITCH,PUSH:(SEE A39S4250 REPL)		
-65	----- -----			1		. SWITCH,PUSH:(SEE A39S3740 REPL)		
-66	361-0542-00			10		. SPACER,SWITCH:PLASTIC	71590	J-64281
-67	175-3049-00			1		CA ASSY,SP,ELEC:4,26 AWG,3.0 L	80009	175-3049-00
	352-0164-09			2		. CONN BODY,PL,EL:6 WIRE WHITE	80009	352-0164-09
-68	175-3050-00			1		CA ASSY,SP,ELEC:9,26 AWG,3.5 L	80009	175-3050-00
	352-0167-07			2		. CONN BODY,PL,EL:9 WIRE VIOLET	80009	352-0167-07
-69	366-1489-23			1		PUSH BUTTON:GRAY--RESET	80009	366-1489-23
-70	----- -----			1		CKT BOARD ASSY:READOUT SWITCH(SEE A35 REPL)		
						(ATTACHING PARTS)		
-71	211-0541-00			2		SCREW,MACHINE:6-32 X 0.25"100 DEG,FLH STL	83385	OBD
						- - - * - - -		
	----- -----			-		. CKT BOARD ASSY INCLUDES:		
-72	384-1136-00			1		. EXTENSION SHAFT:0.95 INCH LONG	80009	384-1136-00
-73	----- -----			1		. SWITCH,PUSH:(SEE A35S3780 REPL)		
-74	220-0802-00			2		. NUT BLOCK:0.325 X 0.4 X0.19,(2)0-80 THRU	80009	220-0802-00
						(ATTACHING PARTS)		
-75	211-0186-00			4		. SCREW,MACHINE:0-80 X 0.125,FILH,SST,SLOT	12360	00A008AHBUU01
						- - - * - - -		
-76	131-0608-00			12		. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-77	366-1559-00			6		. PUSH BUTTON:SIL GY,0.18 SQ X 0.43	80009	366-1559-00
-78	----- -----			1		. SWITCH,PUSH:(SEE A35S3820 REPL)		
-79	361-0542-00			6		. SPACER,SWITCH:PLASTIC	71590	J-64281
-80	----- -----			1		. LT EMITTING DIO:(SEE A35DS3798 REPL)		
-81	----- -----			1		. LT EMITTING DIO:(SEE A35DS4198 REPL)		
-82	----- -----			1		. LT EMITTING DIO:(SEE A35DS3508 REPL)		
-83	198-2582-00			1		WIRE SET,ELEC:	80009	198-2582-00
	352-0169-00			2		. HLDR,TERM CONN:2 WIRE BLACK	80009	352-0169-00
-84	175-3046-00			1		CA ASSY,SP,ELEC:6,26 AWG,5,5 L	80009	175-3046-00
	352-0164-05			2		. CONN BODY,PL,EL:6 WIRE GREEN	80009	352-0164-05

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-	175-3051-00			1		CA ASSY,SP,ELEC:6,26 AWG,6.0 L	80009	175-3051-00
	352-0164-08			2		. CONN BODY,PL,EL:6 WIRE GRAY	80009	352-0164-08
-85	366-0261-03			1		KNOB:SIL GY,0.129 ID X 0.312 OD	80009	366-0261-03
-86	----- -----			1		RES.,VAR,NONWIR:(SEE R5344 REPL)		
						(ATTACHING PARTS)		
-87	220-0877-00			1		NUT,PLAIN,ROUND:0.25-32 X 0.344 DIA	80009	220-0877-00
						- - - * - - -		
-88	175-3218-00			1		CA ASSY,SP,ELEC:6,26 AWG,3.5 L	80009	175-3218-00
	352-0164-04			1		. CONN BODY,PL,EL:6 WIRE YELLOW	80009	352-0164-04
-89	352-0157-00			2		LAMPHOLDER:WHITE PLASTIC	80009	352-0157-00
-90	200-0935-00			2		BASE,LAMPHOLDER:0.29 OD X 0.19 CASE	80009	200-0935-00
-91	----- -----			2		LT EMITTING DIO:(SEE DS5312,DS5322 REPL)		
-92	175-3056-00			1		CA ASSY,SP,ELEC:2,26 AWG,5.5 L	80009	175-3056-000
	352-0169-01			1		. HLDR TERM CONN:2 WIRE,BROWN	80009	352-0169-01
-93	----- -----			1		CKT BOARD ASSY:DISPLAY(SEE A37 REPL)		
						(ATTACHING PARTS)		
-94	211-0097-00			2		SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
	----- -----			-		. CKT BOARD ASSY INCLUDES:		
-95	131-0608-00			20		. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-96	136-0676-00			38		. SOCKET,PIN TERM:FOR 0.016-0.029 DIA PIN	00779	51965-1
-97	136-0673-01			1		. SKT,PL-IN ELEK:READOUT LAMPS,38 CONTACTS	80009	136-0673-01
-98	175-3052-00			1		CA ASSY,SP,ELEC:10,26 AWG,4.5 L	80009	175-3052-00
	352-0168-03			2		. CONN BODY,PL,EL:10 WIRE ORANGE	80009	352-0168-03
	175-3054-00			1		CA ASSY,SP,ELEC:10,26 AWG,4.0 L	80009	175-3054-00
	352-0168-02			2		. CONN BODY,PL,EL:10 WIRE RED	80009	352-0168-02
-99	252-0571-00			FT		NEOPRENE EXTR:CHAN,0.234 X 0.156	77969	1353
-100	343-0427-01			1		RNTR,ELCTRN TU:CRT,FRONT,AL	80009	343-0427-01
						(ATTACHING PARTS)		
-101	211-0021-00			3		SCREW,MACHINE:4-40 X 1.25 INCH,PNH STL	83385	OBD
-102	211-0166-00			1		SCREW,MACHINE:4-40 X 1.750,PNH,STL,CD PL	83385	OBD
-103	166-0085-00			1		SPACER,SLEEVE:0.438 L X 0.133 " ID,BRS	80009	166-0085-00
						- - - * - - -		
-104	386-4270-00			1		SUBPANEL,FRONT:	80009	386-4270-00
						(ATTACHING PARTS)		
-105	210-0586-00			4		NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	OBD
						- - - * - - -		
-106	136-0551-03			1		SKT,PL-IN ELEK:ELCTRN TUBE,11 CONT,W/LEAD	80009	136-0551-03
-107	352-0201-04			1		. HLDR,TERM CONN:5 WIRE YELLOW	80009	352-0201-04
-108	131-0621-00			5		. CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
-109	175-0828-00			FT		. WIRE,ELECTRICAL:5 WIRE RIBBON	08261	SS-0526-710610C
-110	343-0429-01			2		CUSHION,CRT:REAR,URETHANESPONGE	80009	343-0429-01
-111	343-0428-00			1		CLAMP,LOOP:0.85 DIAL	80009	343-0428-00
						(ATTACHING PARTS)		
-112	211-0097-00			1		SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
-113	346-0133-00			1		STRAP,TIE DOWN:0.091 W X 14.0 L,PLASTIC	59730	TY-234M
-114	----- -----			1		COIL,TUBE DEFL:(SEE L5420 REPL)		
-115	----- -----			1		ELECTRON TUBE:(SEE V5440 REPL)		
-116	348-0352-00			4		PAD,CUSHIONING:CRT,FRONT CORNER	80009	348-0352-00
-117	352-0449-00			1		HOLDER,SPEAKER:TELEQUIPMENT	80009	352-0449-00
						(ATTACHING PARTS)		
-118	211-0101-00			2		SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-119	----- -----			1		LOUDSPEAKER:(SEE LS5419 REPL)		
-120	352-0169-00			1		. HLDR,TERM CONN:2 WIRE BLACK	80009	352-0169-00
-121	175-0825-00			FT		. WIRE,ELECTRICAL:2 WIRE RIBBON	80009	175-0825-00
	348-0491-00			1		. CUSHION,SPEAKER:	80009	348-0491-00
-122	----- -----			1		BATTERY SET ASSY:(SEE BT1 REPL)		
						(ATTACHING PARTS)		
-123	211-0101-00			2		SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
						- - - * - - -		
	----- -----			-		. BATTERY SET INCLUDES:		
-124	200-2417-00			1		. COVER,BTRY SET:ALUMINUM	80009	200-2417-00
						(ATTACHING PARTS)		
-125	211-0101-00			4		. SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-126	146-0024-00			4		. BATTERY,STORAGE:1.2V,7000 MAH	19209	XGCW5.6ST
-127	195-0764-00			2		. LEAD,ELECTRICAL:STRD,16 AWG,7.5 L	80009	195-0764-00
-128	----- -----			1		. CKT BOARD ASSY:FUSE(SEE A21 REPL)		
-129	175-3189-00			1		. . CA ASSY,SP,ELEC:3,26 AWG,3.0 L RIBBON	80009	175-3189-00
	352-0161-05			1		. . . CONN BODY,PL,EL:3 WIRE GREEN	80009	352-0161-05
-130	175-3191-00			1		. . CA ASSY,SP,ELEC:4,16 AWG,8.25 L RIBBON	80009	175-3191-00
	204-0646-00			1		. . . CONN BODY,PLUG:4 FEMALE CONTACTS	22526	65486-004
-131	195-3325-00			1		. . WIRE SET,ELEC:16 AWG,4.0 L,5-4	80009	195-3325-00
	195-3326-00			1		. . LEAD,ELECTRICAL:16 AWG,5.0 L,9-1	80009	195-3326-00
	195-3327-00			1		. . LEAD,ELECTRICAL:16 AWG,8.0 L,9-2	80009	195-3327-00
	131-1965-00			2		. . CONN,PLUG,ELEC:SNAP CATCH,30A,BLACK	02929	OBD
	131-1966-00			1		. . CONN,PLUG,ELEC:SNAP CATCH,30A,RED	02929	OBD
						(ATTACHING PARTS)		
-132	210-0405-00			2		. NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	2X12157-402
-133	210-0001-00			2		. WASHER,LOCK:INTL,0.092 ID X 0.18"OD,STL	78189	1202-00-00-0541C
-134	210-1327-00			2		. WASHER,FLAT:0.093 ID X 0.032 THK,STL	86928	OBD
						- - - * - - -		
-135	200-2409-00			1		. COVER,PROT:TRANSISTOR	80009	200-2409-00
						(ATTACHING PARTS)		
-136	211-0105-00			2		. SCREW,MACHINE:4-40 X 0.188,100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-137	----- -----			1		. CKT BOARD ASSY:SWITCH(SEE A22 REPL)		
						(ATTACHING PARTS)		
-138	211-0101-00			1		. SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
						- - - * - - -		
	----- -----			-		. . CKT BOARD ASSY INCLUDES:		
-139	129-0448-00			2		. . SPACER,POST:0.610 L,W/4-40 X 0.25 TAP	80009	129-0448-00
-140	----- -----			1		. . SWITCH,PUSH:(SEE A22S22 REPL)		
-141	175-3193-00			1		. . CA ASSY,SP,ELEC:4,26 AWG,4.5 L RIBBON	80009	175-3193-00
	352-0162-04			1		. . . CONN BODY,PL,EL:4 WIRE YELLOW	80009	352-0162-04
-142	343-0119-00			1		. CLAMP,LOOP:0.094 INCH DIA	95987	3/32-2
						(ATTACHING PARTS)		
-143	213-0138-00			1		. SCR,TPG,TF:4-24 X 0.188 INCH,PNH STL	83385	OBD
-144	210-0994-00			1		. WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5702-201-20
						- - - * - - -		
-145	----- -----			1		. CKT BOARD ASSY:CONTROL(SEE A20 REPL)		
						(ATTACHING PARTS)		
-146	129-0353-00			2		. POST,ELEC-MECH:0.188 HEX X 0.385 INCH LONG	80009	129-0353-00
						- - - * - - -		
	----- -----			-		. . CKT BOARD ASSY INCLUDES:		
-147	131-0608-00			7		. . TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-148	131-1426-00			1		. . CONTACT SET,ELE:R ANGLE,0.250L,STRIP OF 36	22526	65524-136
-149	----- -----			2		. . TRANSISTOR:SEE A20Q12,A20Q17 REPL)		
						(ATTACHING PARTS)		
-150	211-0008-00			2		. SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-151	210-1171-00			2		. WSHR,SHOULDERED:0.116 ID X 0.138 INCH OD	52905	A7148516P2
-152	342-0479-00			2		. INSULATOR,PLATE:TRANSISTOR,FISH DAPER	80009	342-0479-00
-153	342-0322-00			2		. INSULATOR,FILM:TRANSISTOR	80009	342-0322-00
						- - - * - - -		
-154	210-0202-00			1		. TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
						(ATTACHING PARTS)		
-155	210-0407-00			1		. NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
						- - - * - - -		
-156	342-0480-00			1		. INSUL,BTRY SET:F CELL,FISH PAPER	80009	342-0480-00
-157	380-0595-00			1		. HOUSING,BATTERY:F CELLS,ALUMINUM	80009	380-0595-00
	342-0322-00			1		. INSULATOR,FILM:TRANSISTOR	80009	342-0322-00
	348-0672-00			3		. PAD,CUSHIONING:1.0 X 3.0 X 0.25,POLTHN	80009	348-0672-00
-158	334-2128-00			1		MARKER,IDENT:MKD CHARGE RATE WARNING	80009	334-2128-00
-159	334-3380-00			2		MARKER,IDENT:MKD STATIC ELEC CAN DAMAGE	22670	OBD
-160	131-1371-00			3		TERM,FEEDTHRU:0.487 L X 0.20A DIA,BRASS	80009	131-1371-00
-161	358-0176-00			3		INSULATOR,BSHG:	88245	421472
-162	175-3042-00			1		CA ASSY,SP,ELEC:3,26 AWG,8.5 L	80009	175-3042-00
	352-0161-06			1		. CONN BODY,PL,EL:3 WIRE BLUE	80009	352-0161-06

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-163	344-0098-00			2		CLIP,DECORATIVE:CARRYING HANDLE,STL NP	12136	OBD
						(ATTACHING PARTS)		
-164	213-0089-00			2		SCREW,MACHINE:10-32 X 0.375,HEX HD,STL CD	000EL	OBD
-165	210-0010-00			2		WASHER,LOCK:INT,0.20 ID X0.376" OD,STL	78189	1210-00-00-0541C
						- - - * - - -		
-166	367-0037-00			1		HANDLE,CARRYING:	80009	367-0037-00
-167	426-1404-02			1		FRAME SECT,CAB:RIGHT	80009	426-1404-02
						(ATTACHING PARTS)		
-168	211-0101-00			4		SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-169	426-1405-01			1		FRAME SECT,CAB.:LEFT	80009	426-1405-01
						(ATTACHING PARTS)		
-170	211-0101-00			4		SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-171	426-0997-03			2		FRAME SECT,CAB.:FRONT & REAR	80009	426-0997-03



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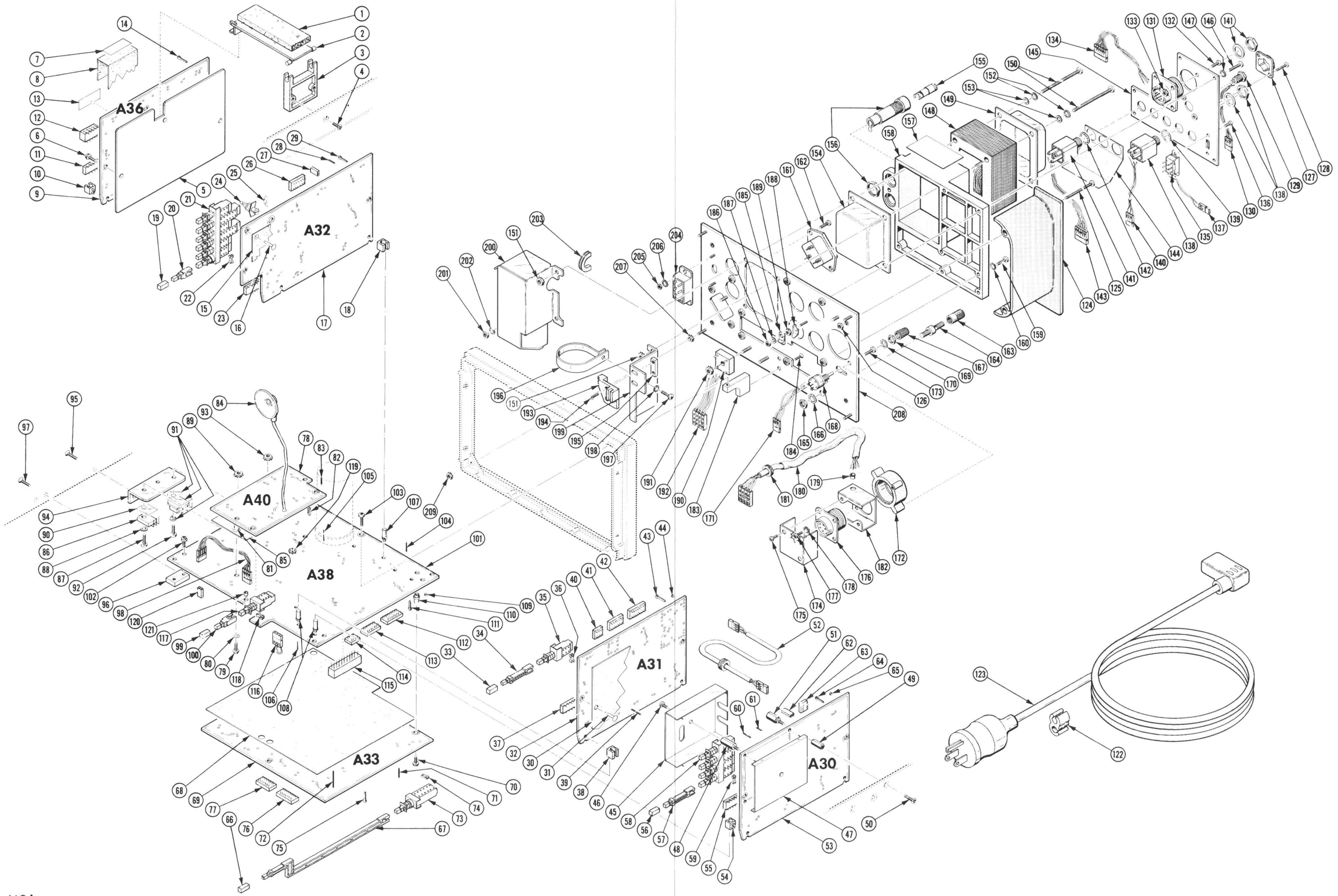
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Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-1	348-0559-00			1		PAD,CUSHIONING:3.0 X 1.0 X 0.312,NPRN FOAM	80009	348-0559-00
-2	343-0432-02			1		RETAINER,CKT BD:POLYCARBONATE SIL GRAY	80009	343-0432-02
-3	214-3074-00			1		HNG,CKT BD RTNR:NYLON	80009	214-3074-00
						(ATTACHING PARTS)		
-4	213-0814-00			2		SCREW,TPG,TR:4-20,0.25 L,PLASTITE	93907	OBD
						- - - * - - -		
-5	337-2410-00			1		SHIELD,ELEC:CIRCUIT CARD	80009	337-2410-00
						(ATTACHING PARTS)		
-6	211-0244-00			3		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
						- - - * - - -		
-7	334-2450-00			1		MARKER,IDENT:MKD DANGER 165	80009	334-2450-00
-8	342-0534-00			1		INSUL,CKT BD:DVM,FIBER	80009	342-0534-00
-9	----- -----			1		CKT BOARD ASSY:DVM(SEE A36 REPL)		
-10	214-2440-00			2		. RECEPTACLE,PIN:CIRCUIT CARD	80009	214-2440-00
-11	136-0461-00			4		. SKT,PL-IN ELEC:CIRCUIT BD,5 CONTACT	80009	136-0461-00
-12	131-2039-00			2		. CONN,RCPT,ELEC:CKT CD,10 FEMALE,DOUBLE ROW	22526	65002-075
-13	334-2450-00			1		. MARKER,IDENT:MKD DANGER 165	80009	334-2450-00
-14	----- -----			10		. TERM,TEST POINT:(SEE A36TP3900,TP3902,TP3903		
	----- -----			-		. TP3904,TP3905,TP3913,TP3918,TP3920,		
	----- -----			-		. TP3937,TP3939 REPL)		
-15	337-2732-00			1		SHIELD,ELEC:CKT BD,FISH PAPER	80009	337-2732-00
						(ATTACHING PARTS)		
-16	214-3012-00			2		FSTNR,SNAP-IN:0.437 L X 0.131 DIA,PNH	80009	214-3012-00
						- - - * - - -		
-17	----- -----			1		CKT BOARD ASSY:PRESSURE/PULSE(SEE A32 REPL)		
-18	214-2440-00			2		. RECEPTACLE,PIN:CIRCUIT CARD	80009	214-2440-00
-19	366-1559-00			6		. PUSH BUTTON:SIL GY,0.18 SQ X 0.43	80009	366-1559-00
-20	384-1136-00			6		. EXTENSION SHAFT:0.95 INCH LONG	80009	384-1136-00
-21	----- -----			1		. SWITCH,PUSH:(SEE A32S3400 REPL)		
-22	361-0542-00			5		. SPACER,SWITCH:PLASTIC	71590	J-64281
-23	136-0461-00			6		. SKT,PL-IN ELEC:CIRCUIT BD,5 CONTACT	80009	136-0461-00
-24	386-1895-00			1		. SUPPORT,CKT BD:CHASSIS MT,PLASTIC	000CP	CBS-4N 1/4
-25	----- -----			1		. BUS CONDUCTOR:(SEE A32R3405 REPL)		
-26	136-0728-00			2		. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
-27	131-0993-00			1		. BUS,CONDUCTOR:2 WIRE BLACK	00779	530153-2
-28	131-0589-00			12		. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-29	----- -----			8		. TERM,TEST POINT:(SEE A32TP3411,TP3412,TP3413,		
	----- -----			-		. TP3415,TP3423,TP3433,TP3454,TP3463 REPL)		
-30	337-2731-00			1		SHIELD,ELEC:CKT BD,FISH PAPER	80009	337-2731-00
						(ATTACHING PARTS)		
-31	214-3012-00			2		FSTNR,SNAP-IN:0.437 L X 0.131 DIA,PNH	80009	214-3012-00
						- - - * - - -		
-32	----- -----			1		CKT BOARD ASSY:RESPIRATION(SEE A31 REPL)		
-33	366-1559-00			1		. PUSH BUTTON:SIL GY,0.18 SQ X 0.43	80009	366-1559-00
-34	384-1099-00			1		. EXTENSION SHAFT:PUSH BUTTON,1.54 INCH LONG	80009	384-1099-00
-35	----- -----			1		. SWITCH,PUSH:(SEE A31S3200 REPL)		
-36	361-0542-00			2		. SPACER,SWITCH:PLASTIC	71590	J-64281
-37	136-0461-00			5		. SKT,PL-IN ELEC:CIRCUIT BD,5 CONTACT	80009	136-0461-00
-38	214-2440-00			2		. RECEPTACLE,PIN:CIRCUIT CARD	80009	214-2440-00
-39	131-0589-00			3		. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
	131-0608-00	XB010402		2		. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-40	136-0727-00			4		. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
-41	136-0728-00	B010100	B010269	1		. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
	136-0728-00	B010270		2		. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
-42	136-0729-00			2		. SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108
-43	----- -----			14		. TERM,TEST POINT:(SEE A31TP3207,TP3210,TP3212,		
	----- -----			-		. TP3218,TP3221,TP3222,TP3225,TP3229,TP3232,		
	----- -----			-		. TP3240,TP3254,TP3259,TP3260,TP3278 REPL)		
-44	136-0252-07			6		. SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-45	337-1816-02			1		SHIELD,ELEC:ECG,FRONT	80009	337-1816-02
						(ATTACHING PARTS)		
-46	211-0008-00			1		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-47	337-1817-00			1		SHIELD,ELEC:ECG REAR	80009	337-1817-00
						(ATTACHING PARTS)		
-48	129-0338-00			1		POST,ELEC-MECH:HEX.,0.188 X 0.64 INCH LONG	80009	129-0338-00
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-49	129-0613-00			1		SPACER,POST:0.8 L,W/4-40 THD ONE END AL	80009	129-0613-00
						(ATTACHING PARTS)		
-50	211-0101-00			1		SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
-51	220-0449-00			1		NUT,SLEEVE:4-40 X 0.188 X 0.50" LONG	80009	220-0449-00
						- - - * - - -		
-52	175-2427-00			1		CA ASSY,SP,ELEC:3,26 AWG,9.0 L	80009	175-2427-00
	348-0003-00			1		. GROMMET,RUBBER:0.312 INCH DIAMETER	70485	1411B6040
	352-0161-01			2		. CONN BODY,PL,EL:3 WIRE BROWN	80009	352-0161-01
-53	----- -----			1		CKT BOARD ASSY:ECG(SEE A30 REPL)		
-54	214-2440-00			2		. RECEPTACLE,PIN:CIRCUIT CARD	80009	214-2440-00
-55	136-0461-00			4		. SKT,PL-IN ELEC:CIRCUIT BD,5 CONTACT	80009	136-0461-00
	136-0728-00	XB010270		1		. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
-56	366-1559-00			4		. PUSH BUTTON:SIL GY,0.18 SQ X 0.43	80009	366-1559-00
-57	384-1099-00			4		. EXTENSION SHAFT:PUSH BUTTON,1.54 INCH LONG	80009	384-1099-00
-58	----- -----			1		. SWITCH,PUSH:(SEE A30S3000 REPL)		
-59	361-0542-00			4		. SPACER,SWITCH:PLASTIC	71590	J-64281
-60	131-0589-00			14		. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-61	131-0608-00			3		. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-62	131-0993-00			3		. BUS,CONDUCTOR:2 WIRE BLACK	00779	530153-2
-63	136-0727-00			7		. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
-64	----- -----			9		. TERM,TEST POINT:(SEE A30TP3002,TP3004,TP3012,		
	----- -----			-		. TP3016,TP3020,TP3021,TP3040,TP3091,TP3097		
	----- -----			-		. REPL)		
-65	136-0252-07	B010100	B010269	12		. SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
	136-0252-07	B010270		18		. SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-66	366-1559-00			1		PUSH BUTTON:SIL GY,0.18 SQ X 0.43	80009	366-1559-00
-67	384-1559-00			1		EXTENSION SHAFT:6.764 L,PLASTIC,BLACK	80009	384-1559-00
-68	342-0496-00			1		INSUL,CKT BD:CONDITIONER BD,FISH PAPER	80009	342-0496-00
-69	----- -----			1		CKT BOARD ASSY:READOUT CONDITIONER(SEE A33 REPL)		
						(ATTACHING PARTS)		
-70	211-0244-00			4		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
						- - - * - - -		
	----- -----			-		. CKT BOARD ASSY INCLUDES:		
-71	131-0608-00			40		. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-72	131-0589-00			60		. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-73	----- -----			1		. SWITCH,PUSH:(SEE A33S3610 REPL)		
-74	361-0411-00			2		. SPACER,PUSH SW:0.13 W X 0.375 INCH L,PLSTC	71590	J64285-00
-75	----- -----			8		. TERM,TEST POINT:(SEE A33TP3619,TP3626,TP3627,		
	----- -----			-		. TP3650,TP3652,TP3655,TP3661,TP3695 REPL)		
-76	136-0729-00			6		. SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108
-77	136-0728-00	B010100	B010269	5		. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
	136-0728-00	B010270		6		. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
-78	----- -----			1		CKT BOARD ASSY:HIGH VOLTAGE(SEE A40 REPL)		
						(ATTACHING PARTS)		
-79	211-0244-00			2		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
-80	210-1160-00			2		WASHER,NONMETAL:0.109 ID X 0.25 INCH OD	86445	OBD
						- - - * - - -		
	----- -----			-		. CKT BOARD ASSY INCLUDES:		
-81	129-0576-00			2		. SPACER,POST:0.393 L,W/4-40 THD,BRS	80009	129-0576-00
-82	136-0263-04			17		. SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	75377-001
-83	131-0589-00			10		. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-84	195-0125-00			1		. LEAD,ELECTRICAL:ANODE	000FB	C5-503V-00
-85	342-0401-00			1		INSUL,CKT CARD:HIGH VOLTAGE	80009	342-0401-00
-86	----- -----			1		TRANSISTOR:(SEE Q4139 REPL)		
						(ATTACHING PARTS)		
-87	211-0014-00			1		SCREW,MACHINE:4-40 X 0.50 INCH,PNH STL	83385	OBD
-88	210-0071-00			1		WASHER,SPR TNSN:0.146 ID X 0.323" OD,STL	78189	4706-05-01-0531
-89	210-0586-00			1		NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	OBD
						- - - * - - -		
-90	342-0163-00			1		INSULATOR,PLATE:XSTR,0.675 X 0.625 X 0.001"	80009	342-0163-00
-91	----- -----			2		TRANSISTOR:(SEE Q4158 & Q4159 REPL)		
						(ATTACHING PARTS)		
-92	211-0097-00			2		SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
-93	210-0586-00			2		NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	OBD
						- - - * - - -		
-94	214-2539-01			1		HEAT SINK,XSTR:(2) TO-3 & (1) TO-127	80009	214-2539-01
						(ATTACHING PARTS)		
-95	211-0101-00			2		SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-96	220-0824-00			4		NUT BLOCK:0.43 X 0.75 X0.09,(2)4-40 THD	80009	220-0824-00
						(ATTACHING PARTS)		
-97	211-0101-00			8		SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-98	175-3190-00			1		CA ASSY,SP,ELEC:4,26 AWG,8.0 L RIBBON	80009	175-3190-00
	352-0162-07			2		. CONN BODY,PL,EL:4 WIRE VIOLET	80009	352-0162-07
-99	366-1559-00			1		PUSH BUTTON:SIL GY,0.18 SQ X 0.43	80009	366-1559-00
-100	384-1136-00			1		EXTENSION SHAFT:0.95 INCH LONG	80009	384-1136-00
-101	----- -----			1		CKT BOARD ASSY:MAIN(SEE A38 REPL)		
						(ATTACHING PARTS)		
-102	211-0244-00			8		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
-103	211-0012-00			1		SCREW,MACHINE:4-40 X 0.375,PNH STL CD PL	83385	OBD
						- - - * - - -		
	----- -----			-		. CKT BOARD ASSY INCLUDES:		
-104	131-0589-00			144		. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-105	131-0591-00			2		. CONTACT,ELEC:0.835 INCH LONG	22526	47352
-106	131-0608-00			133		. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-107	214-2441-00			5		. PIN,SHLDR,HDLS:CIRCUIT CARD	80009	214-2441-00
-108	214-2895-00			3		. PIN,SHLDR,HDLS:0.18 DIA X 0.343 L	80009	214-2895-00
-109	136-0252-07			18		. SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-110	129-0561-00			4		. SPACER,POST:0.535 L,W-4-40 INTL ONE END	80009	129-0561-00
-111	----- -----			8		. TERM,TEST POINT:(SEE A38TP4142,TP4165,TP4186,		
	----- -----			-		. TP4377,TP4383,TP4384,TP4389,TP4393 REPL)		
-112	136-0729-00			3		. SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108
-113	136-0728-00			4		. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
-114	136-0727-00			1		. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
-115	131-2125-00			3		. CONN,RCPT,ELEC:CIRCUIT,BOARD,2 X 10 FEMALE	22526	65783-010
-116	131-2083-00			1		. BUS,CONDUCTOR:2,26 AWG,1.5 L	80009	131-2083-00
-117	----- -----			1		. SWITCH,PUSH:(SEE A38S3730 REPL)		
-118	361-0542-00			2		. SPACER,SWITCH:PLASTIC	71590	J-64281
-119	342-0324-00			2		. INSULATOR,DISC:TO-5 TRANSISTOR	13103	7717-5N-BLUE
-120	131-0993-00			2		. BUS,CONDUCTOR:2 WIRE BLACK	00779	530153-2
-121	129-0647-00			1		. SPACER,POST:0.205 L,W/4-40 THRU THD,BRS	80009	129-0647-00
-122	343-0439-00			1		RTNR,CA TO CA:0.269 OD,POLYETH BLACK	80009	343-0439-00
-123	161-0138-01			1		CABLE ASSY,PWR:3,18 AWG,115VAC,124.0 L	80009	161-0138-01
	020-0680-00			1		. COMPONENT KIT:POWER CABLE	80009	020-0680-00
	129-0920-00			1		. . SPACER,POST:1.6 L W/6-32 INT & EXT THD	80009	129-0920-00
	129-0927-00			1		. . SPACER,POST:1.825 L W/6-32 INT & EXT THD	80009	129-0927-00
	343-1004-01			1		. . CLAMP,LINE CORD:W/THUMBSCREW & WASHER	80009	343-1004-01
-124	348-0530-00			2		FOOT,CORD WRAP:	80009	348-0530-00
						(ATTACHING PARTS)		
-125	211-0607-00			4		SCREW,MACHINE:6-32 X 2.625,PNH,STL	83385	OBD
-126	210-0407-00			4		NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
						- - - * - - -		
-127	343-0617-00			1		RETAINER,CONN:PLUG GUIDE,ABS SIL GRAY	80009	343-0617-00
						(ATTACHING PARTS)		
-128	211-0097-00			2		SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
	210-0551-00			2		NUT,PLAIN,HEX.:4-40 X 0.25 INCH,STL	83385	OBD
						- - - * - - -		
-129	----- -----			1		CONN,RCPT ELEC:(SEE J5340 REPL)		
-130	175-3057-00			1		CA ASSY,SP,ELEC:3,26 AWG,6.0 L	80009	175-3057-00
	352-0161-02			1		. CONN BODY,PL,EL:3 WIRE RED	80009	352-0161-02
-131	----- -----			1		CONN,RCPT,ELEC:(SEE J5345 REPL)		
						(ATTACHING PARTS)		
-132	211-0097-00			2		SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
-133	210-0586-00			2		NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	OBD
						- - - * - - -		
-134	175-2096-00			1		CA ASSY,SP,ELEC:6,26 AWG,4.5 L	80009	175-2096-00
	352-0164-01			1		. CONN BODY,PL,EL:6 WIRE BROWN	80009	352-0164-01
-135	----- -----			1		SWITCH,SLIDE:(SEE S5364 REPL)		
						(ATTACHING PARTS)		
-136	211-0007-00			2		SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-137	175-3038-00			1		CA ASSY,SP,ELEC:2,26 AWG,3.375 L	80009	175-3038-00
	352-0169-04			1		. CONN BODY,PL,EL:2 WIRE YELLOW	80009	352-0169-04
-138	----- -----			2		JACK,TELEPHONE:(SEE J5361,J5362 REPL)		
-139	210-0012-00			2		WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL	78189	1220-02-00-0541C

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-140	175-3039-00			1		CA ASSY,SP,ELEC:3,26 AWG,6.5 L	80009	175-3039-00
	352-0161-07			1		. CONN BODY,PL,EL:3 WIRE VIOLET	80009	352-0161-07
	175-3040-00			1		CA ASSY,SP,ELEC:3,26 AWG,6.0 L	80009	175-3040-00
	352-0161-08			1		CONN BODY,PL,EL:3 WIRE GRAY	80009	352-0161-08
-141	----- -----			3		JACK,TELEPHONE:(SEE J5410,J5412,J5414 REPL)		
-142	210-0012-00			3		WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL	78189	1220-02-00-0541C
-143	175-3045-00			1		CA ASSY,SP,ELEC:6,26 AWG,5.0 L	80009	175-3045-00
	352-0164-03			1		. CONN BODY,PL,EL:6 WIRE ORANGE	80009	352-0164-03
-144	337-2730-00			1		SHIELD,ELEC:OUTPUT CONNECTOR,FISH PAPER	80009	337-2730-00
-145	333-2617-00			1		PANEL,REAR:INSET	80009	333-2617-00
						(ATTACHING PARTS)		
-146	211-0016-00			4		SCREW,MACHINE:4-40 X 0.625 INCH,PNH STL	83385	OBD
	211-0017-00			1		SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD
-147	210-0004-00			5		WASHER,LOCK:#4 INTL,0.015THK,STL CD PL	78189	1204-00-00-0541C
	343-0144-00			1		CLAMP,LOOP:0.125 INCH ID,BLK NYLON	95987	1-8-2
	210-0406-00			1		NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
	210-0994-00			1		WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5702-201-20
						- - - * - - -		
-148	----- -----			1		XFMR,PWR,STPDN:(SEE T5420 REPL)		
-149	200-0105-01			1		. COVER,ELEC XFMR:2.188 X 2.625X 0.875,AL	80009	200-0105-01
						(ATTACHING PARTS)		
-150	211-0552-00			4		. SCREW,MACHINE:6-32 X 2 INCH,PNH STL	83385	OBD
-151	210-0457-00			4		. NUT,PL,ASSEM WA:6-32 X 0.312 INCH,STL	83385	OBD
-152	210-0006-00			2		. WASHER,LOCK:#6 INTL,0.018THK,STL CD PL	78189	1206-00-00-0541C
-153	210-0823-00			2		. WASHER,FLAT:0.14 ID X 0.031 THK,RED FBR	74921	OBD
						- - - * - - -		
-154	200-2463-01			1		. COVER,HALF,XFMR:TAN	80009	200-2463-01
	195-0279-00			1		. LEAD,ELECTRICAL:22 AWG,8.0 L,8-19	80009	195-0279-00
	195-0284-00			1		. LEAD,ELECTRICAL:22 AWG,8.0 L,8-2	80009	195-0284-00
	195-0289-00			1		. LEAD,ELECTRICAL:22 AWG,8.0 L,8-3	80009	195-0289-00
	195-0294-00			1		. LEAD,ELECTRICAL:22 AWG,8.0 L,8-04	80009	195-0294-00
-155	200-2264-00			1		CAP.,FUSEHOLDER:3AG FUSES	S3629	FEK 031 1666
-156	204-0837-01			1		BODY,FUSEHOLDER:3AG,6.3A,250V,PNL MT	S3629	OBD
-157	334-3813-00			1		MARKER,IDENT:MKD CAUTION-FUSE REPL	80009	334-3813-00
-158	361-1008-01			1		SPACER,PLATE:W/FUSE HOLDER,PLASTIC	80009	361-1008-01
						(ATTACHING PARTS)		
-159	211-0014-00			4		SCREW,MACHINE:4-40 X 0.50 INCH,PNH STL	83385	OBD
-160	210-0004-00			4		WASHER,LOCK:#4 INTL,0.015THK,STL CD PL	78189	1204-00-00-0541C
						- - - * - - -		
-161	----- -----			1		CONN,RCPT,ELEC:(SEE J5420 REPL)		
						(ATTACHING PARTS)		
-162	129-0920-00			1		SPACER,POST:1.6L,W/6-32 INT & EXT THD	80009	129-0920-00
						- - - * - - -		
	343-1004-00			1		CLAMP,LINE CORD:ALUMINUM	80009	343-1004-00
						(ATTACHING PARTS)		
	213-0441-00			1		THUMBSCREW:4-40 X 0.375 INCH	80009	213-0441-00
	210-0004-00			1		WASHER,LOCK:#4 INTL,0.015THK,STL CD PL	78189	1204-00-00-0541C
						- - - * - - -		
	195-0700-00			1		LEAD,ELECTRICAL:18 AWG,3.0 L,5-4	80009	195-0700-00
	195-0701-00			1		LEAD,ELECTRICAL:22 AWG,3.0 L,8-19	80009	195-0701-00
	195-0702-00			1		LEAD,ELECTRICAL:22 AWG,3.5 L,8-5	80009	195-0702-00
	195-0703-00			1		XTRICAL:22 AWG,3.5 L,8-6	80009	195-0703-00
	195-0704-00			1		LEAD,ELECTRICAL:22 AWG,3.0 L,8-04	80009	195-0704-00
	195-1490-00			1		EAD,ELECTRICAL:22 AWG,1.5 L,2-1	80009	195-1490-00
-163	200-0072-00			1		NUT,PLAIN,KNURL:0.25-28 X 0.375OD X 0.625L	80009	200-0072-00
-164	355-0503-00			1		STUD,SHOULDERED:BINDING POST,BRS NP	80009	355-0503-00
						(ATTACHING PARTS)		
-165	210-0410-00			1		NUT,PLAIN,HEX.:10-32 X 0.312 INCH,BRS	73743	2X20003-402
-166	210-0010-00			1		WASHER,LOCK:INT,0.20 ID X0.376" OD,STL	78189	1210-00-00-0541C
						- - - * - - -		
-167	366-1825-01			1		KNOB:GRAY,0.127 ID X 0.392 OD	80009	366-1825-01
	213-0153-00			1		. SETSCREW:5-40 X 0.125,STL BK OXD,HEX SKT	000CY	OBD
-168	----- -----			1		RES.,VAR,COMPSN:(SEE R5416 REPL)		
						(ATTACHING PARTS)		
-169	210-0583-00			1		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-170	210-0940-00			1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-171	175-3035-00			1		CA ASSY,SP,ELEC:3,26 AWG,3.0 L	80009	175-3035-00
	352-0161-05			1		. CONN BODY,PL,EL:3 WIRE GREEN	80009	352-0161-05
-172	342-0189-00			1		INSULATOR,CONN:NYLON	80009	342-0189-00
						(ATTACHING PARTS)		
-173	211-0233-00			2		SCREW,TPG,TC:4-24 X 0.438,PNH,STL,CD PL	83385	OBD
						- - - * - - -		
-174	337-1865-00			1		SHLD,ELEC CONN:ECG,TOP	80009	337-1865-00
						(ATTACHING PARTS)		
-175	211-0007-00			2		SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-176	----- -----			1		CONN,RCPT,ELEC:(SEE J5300 REPL)		
						(ATTACHING PARTS)		
-177	211-0233-00			2		SCREW,TPG,TC:4-24 X 0.438,PNH,STL,CD PL	83385	OBD
-178	210-0201-00			1		TERMINAL,LUG:SE #4	86928	A373-157-2
						- - - * - - -		
-179	348-0055-00			1		GROMMET,PLASTIC:0.25 INCH DIA	80009	348-0055-00
-180	175-3044-00			1		CA ASSY,SP,ELEC:3,22 AWG,12.0 L	80009	175-3044-00
-181	348-0003-00			1		. GROMMET,RUBBER:0.312 INCH DIAMETER	70485	1411B6040
	352-0200-00			1		. HLDR,TERM CONN:4 WIRE BLACK	80009	352-0200-00
-182	337-1866-00			1		SHLD,ELEC CONN:ECG,BOTTOM	80009	337-1866-00
-183	386-3781-01			1		SUPPORT,CKT BD:MAIN	80009	386-3781-01
						(ATTACHING PARTS)		
-184	211-0025-00			2		SCREW,MACHINE:4-40 X 0.375 100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-185	343-0144-00			1		CLAMP,LOOP:0.125 INCH ID,BLK NYLON	95987	1-8-2
						(ATTACHING PARTS)		
-186	210-0406-00			1		NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-187	210-0994-00			1		WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5702-201-20
						- - - * - - -		
-188	210-0201-00			1		TERMINAL,LUG:SE #4	86928	A373-157-2
						(ATTACHING PARTS)		
-189	210-0586-00			1		NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	OBD
						- - - * - - -		
-190	----- -----			2		SEMICOND DEVICE:(SEE CR5423,CR5424 REPL)		
						(ATTACHING PARTS)		
-191	210-0457-00			2		NUT,PL,ASSEM WA:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-192	198-4533-00			1		WIRE SET,ELEC:	80009	198-4533-00
	352-0200-01			1		. CONN BODY,PL,EL:4 WIRE BROWN	80009	352-0200-01
-193	351-0543-00			1		GUIDE,CKT BD:SHIELD	80009	351-0543-00
						(ATTACHING PARTS)		
-194	211-0112-00			2		SCREW,MACHINE:2-56 X 0.375,FLH,100 DEG	83385	OBD
-195	220-0853-00			1		NUT BLOCK:0.75 X 0.2 X 0.125	80009	220-0853-00
						- - - * - - -		
-196	343-0920-00			1		CLAMP,LOOP:1.37 ID,ALUMINUM	80009	343-0920-00
						(ATTACHING PARTS)		
-197	211-0198-00			1		SCREW,MACHINE:4-40 X 0.438 PNH,STL,POZ	77250	OBD
-198	210-0004-00			1		WASHER,LOCK:#4 INTL,0.015THK,STL CD PL	78189	1204-00-00-0541C
						- - - * - - -		
	210-0201-00			1		TERMINAL,LUG:SE #4	86928	A373-157-2
						(ATTACHING PARTS)		
	210-0551-00			1		NUT,PLAIN,HEX.:4-40 X 0.25 INCH,STL	83385	OBD
						- - - * - - -		
-199	407-2066-02			1		BRACKET,GUIDE:ALUMINUM	80009	407-2066-02
-200	337-2703-00			1		SHIELD,ELEC:VOLTAGE,SELECTOR,AL	80009	337-2703-00
						(ATTACHING PARTS)		
-201	210-0407-00			1		NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
-202	210-0006-00			1		WASHER,LOCK:#6 INTL,0.018THK,STL CD PL	78189	1206-00-00-0541C
						- - - * - - -		
-203	358-0281-00			1		GROMMET,PLASTIC:BLACK,U-SHAPED,0.375ID	80009	358-0281-00
-204	----- -----			1		SWITCH,SLIDE:(SEE S5420 REPL)		
						(ATTACHING PARTS)		
-205	210-0406-00			2		NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-206	210-0004-00			2		WASHER,LOCK:#4 INTL,0.015THK,STL CD PL	78189	1204-00-00-0541C
						- - - * - - -		
-207	210-0586-00			4		NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	OBD
-208	333-2596-00			1		PANEL,REAR:	80009	333-2598-00
						(ATTACHING PARTS)		
-209	210-0586-00			3		NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	OBD
						- - - * - - -		

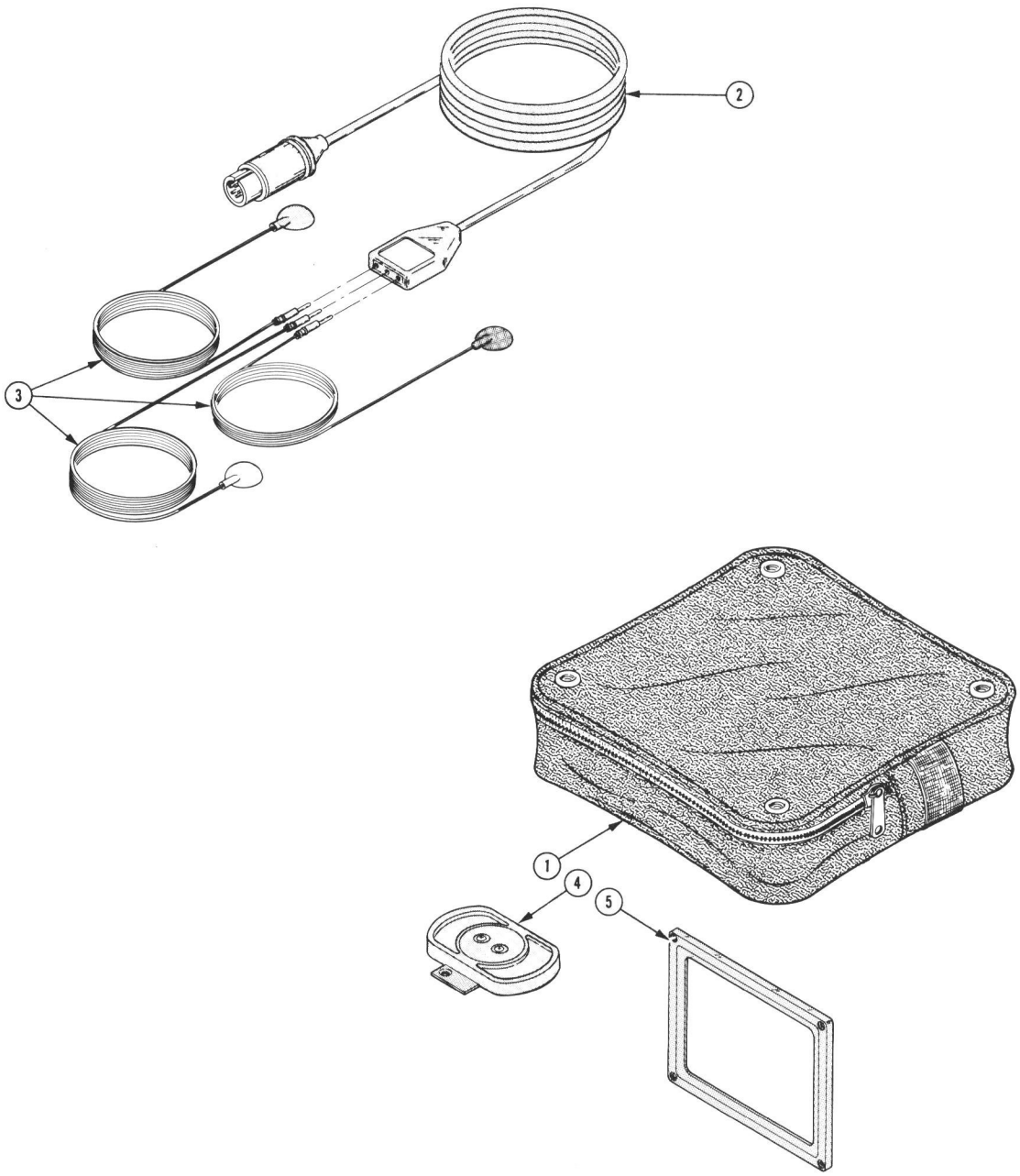

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
3-	016-0560-01			1		POUCH,ACCESSORY:MEDICAL MON,W ACCESSORIES	80009	016-0560-01
-1	016-0560-00			1		. POUCH,ACCESSORY:MEDICAL MONITOR	80009	016-0560-00
-2	012-0739-00			1		. PATIENT CABLE:TORSO,3 WIRE,5 PIN,132.0 L	54516	K-2365
-3	012-0502-00			1		. WIRE,ELECTRODE:3,L/R ARM,L LEG,18 L,SNAPS	80009	012-0502-00
-4	014-0054-00			1		. ADAPTER,MTG:	80009	014-0054-00
-5	200-1547-01			1		. RTNR,CRT SCALE:4.95 X 3.95 X0.18 NYLON	80009	200-1547-01
	070-2893-00			1		MANUAL,TECH:OPERATORS	80009	070-2893-00
	070-2894-00			1		MANUAL,TECH:SERVICE	80009	070-2894-00

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Tektronix®
COMMITTED TO EXCELLENCE

MANUAL CHANGE INFORMATION

Date: 3-4-81 Change Reference: C6/381

Product: 413A PORTABLE NEONATAL MONITOR Manual Part No.: 070-2894-00

DESCRIPTION

EFF SN C010300 (Pilot Change #25)

EFF SN C010219 (Pilot Change #27)

REPLACEABLE ELECTRICAL PARTS AND SCHEMATIC CHANGES

			REF.
CHANGE TO:			
A31R3262	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W	PC #27
A31R3263	315-0105-00	RES.,FXD,CMPSN:1M OHM,5%,0.25W	PC #27
A31R3287	315-0474-00	RES.,FXD,CMPSN:470K OHM,5%,0.25W	PC #27

R3262, R3263 and R3287 are located on the RESPIRATION circuit board assembly and are shown on diagram 2 RESPIRATION.

ADD:			
A33C3646	281-0763-00	CAP.,FXD,CER DI:47PF,10%,100V	PC #25
A33C3656	281-0763-00	CAP.,FXD,CER DI:47PF,10%,100V	PC #25
A33C3868	281-0763-00	CAP.,FXD,CER DI:47PF,10%,100V	PC #25
A33C3878	281-0763-00	CAP.,FXD,CER DI:47PF,10%,100V	PC #25
A33C3890	281-0763-00	CAP.,FXD,CER DI:47PF,10%,100V	PC #25

C3646 and C3656 are added in parallel with R3646 and R3655 respectively; shown on diagram 4 TEMPERATURE AND RATE CONVERTERS.

C3868, C3878 and C3890 are added in parallel with R3868, R3878 and R3890 respectively; and are shown on diagram 6 READOUT SWITCHING AND PRESSURE CONVERTERS. All of the above capacitors are located on the CONDITIONER circuit board assembly.

Tektronix®
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MANUAL CHANGE INFORMATION

Date: 1-29-81 Change Reference: C20/181

Product: 400,401,408,412,413,413A & 414 SERVICE Manual Part No.: see below

DESCRIPTION

400 (070-2429-00)

401 (070-2497-00)

408 (070-1525-00)

412 (070-1523-00)

413 (070-2277-00)

413A (070-2894-00)

414 (070-2042-01)

PORTABLE PATIENT MONITORS

After 12 January 1981, serial numbers of the above named instruments start with "C" instead of the beginning "B" previously used.

A number of instruments were already assembled and awaiting shipment when the change in serial numbers occurred. On these instruments the serial number tag on the rear of the instrument will commence with "C"; the serial number on the frame or chassis will be the same except that it will begin with a "B".